The Landed Interest and the Development of the South Yorkshire Coalfield 1750 to 1830

Thesis

IAN RAOUL MEDLICOTT, B.A.

THE LANDED INTEREST AND THE DEVELOPMENT OF THE SOUTH YORKSHIRE COALFIELD 1750 to 1830

MASTER OF PHILOSOPHY

ARTS DISCIPLINE

1981

Date of submission: 1.11.81
Date of award: 28.6.82

ABSTRACT OF THE THESIS SUBMITTED FOR THE MASTER OF PHILOSOPHY DEGREE IN THE OPEN UNIVERSITY

The Norfolk and Rockingham-Fitzwilliam families possessed the two most extensive landed estates in South Yorkshire. It was the consolidated nature of the property which placed the owners in a favourable position for the exploitation of minerals. This is essentially a comparative study between the two great landed estates in the development of their collieries. Both landed proprietors were initially reluctant to take the collieries into direct management, but once the financial situation forced them to do so, the ensuing capital investment turned their mines into the most extensive in South Yorkshire. Although the thesis is concerned mainly with the expansion and management of the collieries, no work of this kind can omit social factors relating to mining, and therefore these will be referred to where appropriate.

The expansion and profitability of the two mining enterprises were determined by transport developments. Whereas Norfolk sought to protect his Sheffield market by opposing transport schemes into Sheffield, Rockingham and Fitzwilliam actively participated in schemes that appeared to open more extensive markets. However, neither landed proprietor was able to break out of the limited South Yorkshire market, before the coming of the railways.

The proprietors of extensive collieries in the eighteenth century were pioneers in mining technology and it was in this area that the Norfolks, in particular, made notable contributions. But problems associated with management and accounting were not adequately solved. Although the proprietors of both estates could exercise control only from a distance, they were not prepared to delegate managerial responsibilities. This led not only to inefficiency but an inadequate response to changing market conditions. In accounting, too much reliance was placed on the steward and master system - then common practice on the landed estates. They were unable to come to terms with current and capital accounts, with little attempt at depreciation accounting,

which disguised the true profit situation of their collieries. Even so, the owners of the Sheffield and Wentworth estates were pioneers in large-scale mining, and it was on their capital investment, technological innovations, and development of coal markets that the nineteenth century coal industry in South Yorkshire was built.

Contents

Table of Illustrations

INTRODUCTION

The South Yorkshire Coalfield forms one significant part of the much larger Yorkshire, Derbyshire and Nottinghamshire coalfield. Even so, it was not until the opening up of a national market, with the introduction of railways, that it acquired such a premier position among the nation's coal mining areas. This expansion could not have been realised without the capital investment made during earlier decades by the landed interest, and it is with this period between 1750 and 1830 that this study is concerned. The period covers the first major expansion of the South Yorkshire coal industry, from its small-scale exploitation through an era of rapid investment, to the coming of the railways. The year 1830 is an appropriate date to conclude the study, as by then the majority of landowners had divested their mining interests and the impetus provided by the railways created a second expansion of the industry. It was the development of the coal industry between 1750 and 1830 that enabled colliery proprietors to exploit the vast demand for coal after 1850. Such a period of large-scale mining not only demanded heavy capital investment, but also the introduction of technological innovations and modern management practices.

This work is essentially a comparative study of coal mining on two great landed South Yorkshire estates, owned by the Norfolk and Rockingham-Fitzwilliam families. Owners of such extensive coal reserves had the choice of either directing the management of their own mining enterprise or accepting the relatively less onerous position of lessor. The understanding of any particular course of action must necessarily involve the complex area of individual human motivation, in this case it is made more difficult by the paucity of documentary evidence. However, there are certain factors, such as the profitability of their mining enterprises, which encouraged continued direct management by landed families in entre-

preneurial activities. Once the landed interest was committed to the direct management of their collieries, their attitude and degree of involvement varied between landowners. They had to solve the problems of large-scale mining associated with drainage, ventilation, sales, transport, and management. It was the degree of success and level of expenditure required to overcome these difficulties that often determined whether the landed interest continued with the direct exploitation of their coal reserves. The latter half of the eighteenth century witnessed heavy capital investment in pumping and winding engines, the opening up of new markets, alongside improvements in transport to enable the cheap bulk movement of coal. In addition, specialised mining skills had to be acquired by existing estate workers or introduced from more technologically advanced coalfields, whilst management and accounting techniques had to be modified for large-scale industrial units.

The landed interest did not develop the coal industry in isolation but alongside the capitalist proprietor, although their approach and attitude towards mining was not necessarily similar. The Norfolks reflect those landowners who withdrew from direct management to the relatively secure position of lessor, whilst the Rockingham-Fitzwilliam family not only held onto their collieries but further developed their mining enterprise. Whilst the thesis is essentially a comparative study between the Norfolk and Rockingham-Fitzwilliam mining interests, an attempt has been made to place them in a national perspective to ascertain how typical they were of the landed class in the exploitation of coal.

The primary evidence has been collected mainly from the Wentworth Woodhouse and Arundel Castle archives placed in the Sheffield City Library. These include, estate and colliery accounts, deeds, wage books, reports, valuations and correspondence. Gratitude is expressed towards those who have allowed me to study their manuscripts and in particular to the Duke

of Norfolk and the Trustees of the Wentworth Woodhouse Estate. Assistance has also been given by the staff of the Department of Local History and Archives at the Sheffield City Library and Arthur Clayton, a local historian.

CHAPTER ONE

COAL MINING AND THE LANDED INTEREST

There was no common factor which determined the degree of direct involvement by the landed interest in the development of their estates: 'The diversity of the response of the British landed aristocracy to the opportunities created in the industrial revolution is sufficient to render inadequate all but the most capacious generalisation about the class as a whole.'[1] Apart from such great landowners as the Norfolk and Rockingham-Fitzwilliams, the South Yorkshire landed interest were, on the whole, content to remain as mineral lessors. There were several reasons for the reluctance to undertake the responsibilities of direct management. As lesser landowners, many lacked the necessary capital to finance a mining enterprise, especially during the period of rising costs in the early nineteenth century, whilst the cost of employing agents and viewers and purchasing freeholders' coal was a major deterrent to potential entrepreneurs. In addition, the complex engineering and managerial skills required in the exploitation of the deeper coal distanced the landowner from mining, whilst many found the small returns insufficient to warrant the risks of direct control. It was from the relatively secure position of lessor that the small landowner conducted the exploitation of his mineral resources.

On the coalfield to the north, lay the Bretton Hall estate of 9,000 acres from where Sir Thomas Wentworth, the 5th and last baronet, assumed the name of Blackett on inheriting part of an estate of a Northumberland and Durham mine owner. When Colonel Thomas Beaumont married Diana Blackett, the heir of Sir Thomas Wentworth, the Beaumonts owned a total of 9,000 acres in Yorkshire and 15,000 acres in Northumberland and Durham. In addition, the business interests included, as part of their inheritance, the Allendale lead mines, the lease of smelting mills and the Weardale mines leased from

the Ecclesiastical Commissioners. Thomas Wentworth Beaumont was reputed to have amassed an annual income of £100,000, and at the point when the Lambtons moved into the aristocracy, they numbered among the wealthiest commoners in the kingdom.(2) In spite of a considerable personal fortune, the Beaumonts preferred to lease their South Yorkshire collieries, probably on account of the fact that the mineral revenue was a small proportion of their agricultural rents. They may not have thought it worthwhile to directly manage such small mines with relatively insignificant profits, and therefore were content to lease their collieries. These were located at Bretton, Cleckheaton and High Hoyland, with three at Flockton and three plus a railroad at Wibsey, and a further two at Cumberworth and Darton which were not paying a rent in 1829. Even by 1844 when the number of collieries had risen to 15, the total rent had only increased to £1,800.(3)

To the south, the Vernon-Wentworths of Wentworth Castle, also leased their collieries. Although the colliery rents had risen to £1,023 by 1814, with additional payments for coal mined in excess of 15,000 tons, it represented a small proportion of total revenue. Nevertheless, without being directly involved in mining, the family provided financial assistance to their lessees during difficult economic periods.(4) The Duke of Leeds also leased coal on his widely dispersed estates at Kiveton, Barnsley and Wakefield. It was probably the very nature of the estates that determined whether the Duke should lease or directly manage the collieries, for the lack of a consolidated land holding raised the problem of negotiation for purchasing freeholders' coal, and overcoming obstacles put forward by rival proprietors. Leasing would relieve the landowner from such complex negotiation but he would still be relatively sure of receiving a regular income from rents. In Rotherham the Earl of Effingham leased valuable coal and ironstone reserves to the Walkers who established extensive ironworks at Holmes. The industrial development of his estate was on such a scale that he was forced to move to Thundercliffe Grange near Sheffield.

Several of the lesser landowners relied more on their mineral revenues than those with longer tenant rolls. To the south of Barnsley, the Edmunds of Worsbrough Hall held 1,462 acres containing valuable reserves of coal which produced £10,322 for W H Martin-Edmunds in 1873. Nearby, the Elmhirst family leased their coal and ironstone to local entrepreneurs. In 1800 for example, an agreement was made with Richard Swallow, ironmaster, to mine ironstone at £140 per annum.(5) Whilst at Thrybergh Hall, the Fullertons drew three-quarters of their income from property around Denaby, Kilnhurst, Mexborough and Thrybergh.(6)

There were colliery proprietors whose success enabled them to purchase landed estates and so enter the ranks of the gentry. For example, one such entrepreneur Joseph Charlesworth, who owned seven pits in 1809, was able to purchase Chapelthorpe Hall from Colonel Thomas Beaumont in 1814.(7) The Charlesworth mining enterprise was further extended by John Dodgson Charlesworth, whose 2,500 miners from 6 West Yorkshire and 4 South Yorkshire collieries, were able to celebrate a wage increase in 1853. By 1883, the family owned 2,169 West and North Riding acres which returned a revenue of £7,126.(8) In 1787 another colliery proprietor, Jonas Clarke, purchased Noblethorpe Hall with an estate of 92 acres and adjacent land whose valuable mineral deposits enabled the Clarke family to build a substantial industrial enterprise containing collieries, coke ovens and lime kilns.(9)

Apart from the great landowners and the capitalist entrepreneurs who joined the ranks of the gentry, the South Yorkshire landed interest, on the whole, took no direct interest in the exploitation of their mineral resources. However, the revenues received from their mineral leases had a 'far-reaching effect' on many Yorkshire estates, not least by subsidising agriculture during the years of depression. Although several landowners assisted their lessees during periods of economic slump by foregoing rents or lending money, their most profound effect was as leading promoters, planners

and directors in turnpike, canal and railway schemes.(10)

Turnpike improvements in South Yorkshire had the dual purpose of assisting the movement of agricultural goods as well as the output from collieries. There are numerous illustrations of this. The capital for the Wakefield to Sheffield road, improved in 1754, was provided largely by those landowners through whose property it traversed. These included the Lords Norfolk, Strafford, Rockingham and Sir Thomas Wentworth. In addition a clause to turnpike the Rotherham to Tankersley road on the Wakefield to Sheffield turnpike was promoted by Rockingham and his colliery lessee, Fenton. And there are other examples, the chief subscribers of the Rotherham and Pleasley Trust included the Dukes of Portland and Leeds, whilst the Gander Lane Trust entering Sheffield from the south, had as its principal shareholders the Dukes of Leeds and Devonshire and George Townsend, lessee of the Norfolk collieries. The Sheffield to Penistone turnpike was of particular value to the owners of local coal and iron bearing lands, and this, too, was reflected in the chief shareholders. The initial subscribers included the Duke of Norfolk and Earl of Bute, and when the road was improved in 1825 over half of the new capital came from the Wortley family and Newton Chambers and Co. Of particular importance to industry around Rotherham, was the turnpiking of the road from Swinton to Rotherham in 1809, which was largely financed by Earl Fitzwilliam, Lord Milton, and such industrialists as the Walkers, Kents and Bingleys.(11)

Local turnpikes greatly assisted in the movement of raw materials and finished products. The Wakefield to Sheffield road was of particular importance to the Chapel ironworks at Chapeltown, whilst coal from the Wortley estate, and the Westwood Colliery owned by the Marquis of Rockingham, could be carried more conveniently into Rotherham and Sheffield. Not only did the landed interest provide the necessary capital for the turnpike trusts, but their political influence was essential in carrying the Bills through

Parliament. But it was the involvement by the landed interest in canal schemes that had a more significant impact on the coal trade. In South Yorkshire, the construction of the Dearne and Dove Canal in 1804, enabled the opening up of the adjacent Barnsley, Silkstone and Parkgate seams. The canal, for example, enabled the large-scale exploitation of coal on the Elmhirst and Edmunds estates at Worsbrough. It is hardly surprising, therefore, that William Elmhirst became a major promoter of the canal with the purchase of £300 of shares for himself, and £200 each for his mother and father-in-law.(12) Apart from Earl Fitzwilliam, other landowners with coal-bearing property with shares in the company included the Duke of Leeds, Sir L Copley, Sir G Wombwell and Sir F Woods. The Duke of Leeds, a major promoter of navigation schemes, also had an interest in the Barnsley Canal along with Lord Hawke, Countess Dowager of Bute, and the Earl of Wigtown. The Barnsley Canal, by linking the Aire and Calder Navigation with the Dearne and Dove Canal, was expected to open up the extensive coal seams around Barnsley and Silkstone.(13)

The coming of the railways held out the promise of greatly extended coal markets, and the landed interest were not slow to invest capital in branch lines that had a direct influence on their estates. The Rotherham to Sheffield Railway, opened in 1838, was promoted to break the Norfolk coal monopoly in Sheffield. In response Norfolk attempted to acquire new markets in Lancashire, and with Lord Wharncliffe, who owned coal-bearing lands at Wortley, promoted the Sheffield, Ashton-under-Lyne and Manchester Railway Company.(14)

Some indication of the landowners' participation in railway projects can be seen in parliamentary returns on railway subscription contracts, although these are not a reliable guide to actual investment. The 1846 parliamentary session recorded several West Riding landowners signing contracts including the Charlesworth family £14,600, Frederick Vernon-Wentworth

£16,720, Godfrey Wentworth of Woolley Park £3,750, Earl of Mexborough £17,000, Lord Wharncliffe £10,000, John Spencer-Stanhope of Cannon Hall £5,542 and Thomas Taylor of Dodworth £11,625. The Sheffield, Rotherham, Barnsley, Wakefield, Huddersfield and Goole Railway in 1849, was dominated by such landowners as Beaumont and Wentworth, whilst during the 1850's the South Yorkshire Railway was presided over alternatively by Lords Fitzwilliam and Wharncliffe. The landed interest as well as providing capital, used its political influence to push schemes through parliament, for example, 1st Baron Wharncliffe who as chairman of a Parliamentary Committee, was influential in helping to secure the passing of the Great Western Railway Bill.(15)

The South Yorkshire landowners also assisted the coal mining industry by their active interest in mining institutes and committees. Colonel Thomas Beaumont, with considerable interests in Northumberland and Durham, took an active concern in local affairs of the north-east, and after the Brandling Main Colliery explosion in 1812, became a member of a society to prevent mining accidents, from whose activities came the Davy lamp. W B Beaumont later became a patron of the North of England Institute of Mine Engineers, and with the 1st Earl of Wharncliffe, was one of the initial patrons of the Newcastle Institute in 1849. During the same year the Earl of Wharncliffe presided over a Select Committee to examine the prevention of accidents, and although few conclusions were reached, it did recommend the inspection of collieries.(16)

The involvement by the South Yorkshire landed interest in the exploitation of minerals, was to a considerable extent a microcosm of the national pattern. It was generally the larger landowners in the country who directly managed their colliery concerns, with the lesser landowners in general playing the role of lessor. Initially it was the large estates with substantial coal reserves and good returns, which encouraged direct control, but even

the majority of great landowners by the early nineteenth century had divested themselves of their mining interests.

The larger landowners, who numbered some 2,250 by the 1870's occupied nearly half the enclosed land in England and Wales, and thus any industrial enterprise dependent on land could not but affect the landowner, and many of the more substantial landowners provided much of the capital in the coal and iron industries during the late eighteenth century.(17)

In the 1830's, the 1st Earl of Durham worked six collieries with four more lying unworked, and ran a private railway to Sunderland from where his coal was shipped to London. A valuation of the working collieries made by John Buddle in 1835, amounted to £384,331 with the colliery stock and railway adding a further £156,364. This level of investment enabled the Earl of Durham to produce 429,300 tons of coal in 1829 in comparison to the 141,807 tons from the six collieries worked by Earl Fitzwilliam in 1826.(18) However, although there are no precise figures available, the evidence strongly suggests that Fitzwilliam coal could be worked at a proportionately lower level of capital investment. During the first half of the nineteenth century, the Earl of Lonsdale invested about £5,000 per annum in his collieries and between 1812 and 1841 spent almost £145,000 above the normal working costs, and opened 14 new pits. This investment produced profits between 1812-43 of £1,146,313, with four collieries in 1834 returning the sum of £24,005 net profit. For some members of the landed aristocracy, coal had always been, and during this period still remained the foundation of their wealth. For example, the Earl of Balcarries between 1788-1835, ran the Haigh ironworks, maintained 35 boats and barges along with several collieries. In 1833, Lord Londonderry received a colliery revenue of £40,000 which far outweighed the agricultural rent of £18,047. It was this very dependence on mineral revenues that persuaded many landowners to take a more active role in colliery management.(19)

This kind of activity was paralleled elsewhere. The Dukes of Devonshire with their family seat at Chatsworth, owned collieries and lead mines in Derbyshire, lead mines in Yorkshire, with slate quarries, iron mines and railways in Lancashire, but the major Devonshire investment involved the development of Barrow-in-Furness. The economic expansion of Barrow-in-Furness illustrates the '... application of landed wealth to industrial development in a small corner of England.'(20) There had been a heavy drain on the Devonshire resources prior to 1840 as a result of previous extravagance. Although the mines exported around 40,000 tons of haematite ore annually, they were small and backward, and poor communications made passage to Barrow difficult. After taking up residence in the area in 1840, Lord Burlington, later the 7th Duke of Devonshire, reorganised the slate quarries and installed an inclined plane to the Furness railway, and then leased the concern at a higher rental. Lords Burlington and Buccleuch built the Furness Railway as a mineral line to carry ore and slate to the coast, and out of an original outlay of £75,000, they each contributed £15,000 and of debentures totalling £25,000, Burlington's share was £4,000. By 1848 Burlington was actively employed on the railway board as chairman, and sat on several committees to attain economy-saving schemes. Not satisfied with the Furness Railway, he promoted other lines to connect his industrial empire with the national network and with the development of docks and harbour facilities, Barrow was able to rival Liverpool. The development of Barrow harbour attracted industry to the area in which Burlington held a capital interest. Schneider and Harvey established an ironworks in 1858, followed in the next decade by a Bessemer ironworks, and between 1870-3 a shipyard, jute works, rolling mill, brickworks, builders yards, foundries, engineering and wagon works, were all added. As a result of the economic development of Barrow, its population increased from 150 in 1846 to over 40,000 by 1873.(21) Much of the capital for the Furness district came largely from outside the area, and especially from the Dukes Devonshire and Buccleuch. After 1874 with the

economic depression in the area, the Devonshire family invested even more capital to 'shore up' the ailing industries. Pollard summarises their efforts as an attempt to maximise profits with paternal feelings for their dependents shareholders and new population without any '... understanding of the historical setting or the potentialities of the industries.'(22)

The Dudley estate centred on Dudley Castle, was another example of how a landowner with extensive property and valuable reserves of coal and iron ore was able to make a major contribution to the economic development of a region. The first period of rapid growth between 1774 and 1833 was carried out by the 2nd Viscount Dudley, but according to Raybould its profitability and efficiency was marred by anachronistic managerial practices and a lack of long term planning. This was followed by a further period of expansion between 1833 and 1845, when the estate was held in trust.(23)

The Dudley estate had a long tradition of mineral and iron working which facilitated the development in the eighteenth century of mining, quarrying, brickmaking, ironworks, canals and railways. As the revenue from industrial undertakings comprised a major proportion of total estate income, this in turn provided a further incentive for the landowner to develop those aspects of the estate economy that provided the most lucrative returns. Certain factors combined to produce an economic revolution on the estate which according to T J Raybould created a microcosm of eighteenth century society: 'These were capital availability, transport, improvements, technological innovation, growing demand, and the development of the iron trade as the leading sector of the regional economy.'(24) In this, the 2nd Viscount Dudley: '....acted as the agent of change motivated by a desire to exploit the general impulses to expansion.'(25) Lord Dudley was an example of a great landowner prepared to develop his estate by personal action and parliamentary legislation, exploiting his estate as an economic unit with all aspects of policy inter-dependent, including enclosures, road and canal schemes, estate managed mineral enterprises, along with the leased coal and iron reserves. Parliamentary enclosures

were used to consolidate existing land, extend the estate's mineral resources and protect their right of access. Some £6,200 was provided by Lord Dudley in the 1770's and 1780's to finance road improvements to extend their markets, and in 1774 he introduced a bill to cut a canal from the Staffordshire and Worcestershire canal to Stourbridge known as the Stourbridge Navigation. In 1778 a further canal was cut from Stourbridge to his mines near Dudley along which most of the estate's industrial development was established between 1778 and 1833. The total value of canal shares purchased by Dudley amounted to £19,920 by 1853 and connecting the canals to the estate collieries and ironworks was an extensive network of horse-drawn mineral railways.(26) Although there were some 11 ironworks on the estate by 1836, like many other landowners they were by this time all leased and returning £3,184-14-8 in rents.

The Dudley collieries remained under direct management and provided the most lucrative part of the estate's activities. However, it was not until after 1797 when the pits were reorganised by Charles Beaumont, following the dismissal of Cockshutt for incompetence, that the collieries realised anything like their true potential. Average net profits began to rise significantly after 1836 following the advice of Richard Smith, mineral agent, to lease parts of the existing collieries, whilst retaining the most profitable sections. The combined result of these changes was that by 1844 the Dudley estate was a high output and lucrative enterprise.

In the north west of England the Cumberland coalfield centred on Whitehaven, was developed by the Lowther family during the eighteenth century, until the port was able to rank, for a while, with other leading ports in the country. Lowther and his son James who succeeded to the estates in 1733, invested over £500,000 in one of the collieries. When Sir James died in 1754 the collieries brought in nearly £20,000 a year, and he was supposed to be worth nearly £2 million.(27)

The close proximity of the coalfield to the coast reduced the problems associated with the movement of coal to Whitehaven, from where it was shipped to Ireland, the major market. The major problems which the Lowthers had to face were a remote location and sparse population. The shortage of labour which resulted from this situation, led to severe competition among neighbouring collieries, that in turn increased wages, and a reliance on recruitment from other parts of the country.

Following the appointment of John Bateman as manager in 1802, on a salary of £500 per annum, the Lowthers invested considerable sums in opening new mines, notably the William Pit begun in 1804 and completed in 1812. In some respects the Lowther collieries were leaders in technological innovations under their managers Carlisle Spedding, James Spedding and John Bateman. The first steam engine for winding coal was installed in 1791, and an attempt was made in 1812 to use a locomotive to carry coal to the harbour, whilst Carlisle Spedding's method of 'coursing air' by stoppings and doors was adopted throughout the Kingdom. In other respects the collieries were backward; primitive underground haulage methods were used, iron rails were not installed underground until 1806, nor a steam pumping engine until 1815.(28) The lack of capital investment in high cost equipment may reflect the aim of maximising output, sales, and profits, by reducing expenditure, a policy that appeared to have worked, for by 1806 profits at the Whitehaven Colliery which had a chequered financial history were improving in spite of increased costs.(29)

Eastward across the Pennines lay the premier coalfield of Northumberland and Durham, where as late as 1854, the region accounted for more than a quarter of England's output of coal. It owed its position to the huge quantities of easily accessible seams of coal, in conjunction with the navigable rivers of the Tyne, Wear, and Tees, to which railways carried the coal from numerous collieries. In 1830 for example, some 3,800,000 tons of coal was shipped from its ports, whilst total colliery investment on the Tyne was esti-

mated at £1,500,000 by 1829, with those on the Wear adding a further £6-700,000.(30)

Revenue from minerals comprised the major proportion of total revenues for many landowners on the North East coalfield. This would account for their direct involvement in the mining industry, as their wealth and social status depended upon the efficient exploitation of the coal reserves. Many of the mining entrepreneurs came from the landed interest who invested the major proportion of the capital in the industry and among the largest landowners could be found the Lords Londonderry and Durham. In 1829, Lord Durham who owned an estate of 17,000 acres centred on Lambton Castle, directly controlled his mining empire through capable agents such as Henry Morton. A report by John Buddle in 1835, found the collieries managed with "judgement and economy", and showing a profit of £24,000 for the first six months of the year. The collieries, inclusive of working mines, stock and railways were valued at £540,000 and included 10 collieries in total, although only six were working mines.(31) Several of the dormant collieries or tracts of coal-bearing land were kept as an obstacle to rival proprietors, and to reduce competition. Writing in 1860 W. Fordyce stated that the Marchioness of Londonderry and the Earl of Durham, who both worked around 12 collieries:

> 'At their numerous and extensive collieries, the best and most approved machinery is efficiently maintained. The conducting and working of the collieries are superintended by intelligent managers and mining engineers, and recent discoveries in mining sciences are readily adopted, regardless of expense.'(32)

It would be incorrect to suppose that all the larger landowners in the north-east directly managed their mines, the Earls of Scarbrough, for example, who owned estates in Durham, Yorkshire and Lincolnshire, tended to lease their collieries from the latter half of the eighteenth century. However, their mineral income did not represent such a major proportion of total estate

revenue, and being absentee landlords, their energies were divided between activities on other estates. The average income from their collieries between 1822-31 amounted to only £2,013, which was insignificant in comparison to the revenues received by Lord Durham. However, Scarbrough was prepared to develop his mineral resources by investing in new collieries, and between 1776 and 1779, the Lumley Colliery was sunk, on which £17,000 was expended from May 1777 to October 1783.(33) The colliery did not remain for long under direct management; in 1781 it was leased to John Cole of Chester-le-Street, but after encountering difficulties in raising working capital, Cole soon asked Scarbrough to take the colliery once more in hand. The mine was only taken into direct management from necessity, as was shown by the fact that in 1782 General Lambton took over the lease.

The Butes on their Glamorgan estates in South Wales provide a further example of how a great landowner can create the necessary conditions for the industrial development of a region. Once the 2nd Marquis had realised the economic potential of his mineral resources, he set about providing those conditions favourable to their exploitation. The West Bute Dock was constructed at Cardiff to provide a point of disposal for the coal and open up the coalfield. To this end the 2nd Marquis expended some £350,000 on the Dock which was later to become part of the greatest coal port in the world.(34) In addition, to enable the efficient exploitation of his coal and to safeguard the long term working of the collieries, several neighbouring estates were purchased amounting to £220,000 between 1814 and 1819.(35)

Bute was also eager to exploit the coal on his Rhondda estate for which he required an extension up the valley of the Taff Vale Railway. However, the 2nd Marquis was unable to persuade a coalmaster to open a colliery, due to the depth and remoteness of the coal, nor interest the Taff Vale Railway Company, and so the trustees of the 3rd Marquis decided to open a mine for themselves at Cwmsaerbren in 1850. The idea was to prove the workability of

the coal and encourage the Taff Vale Railway Company to construct the line.

Although the 2nd Marquis directly managed his collieries in County Durham he sought to lease the minerals on his South Wales estates. This course of action was necessary according to the Marquis, because unlike the merchants in South Wales those on the Tyne were 'long established' and 'well known', with less risk of incurring bad debts.(36) In writing about the Butes, J. Davies states that where they directly worked their minerals, profit was not the prime objective. The 2nd Marquis, for example, opened a colliery at Rhigos in order to employ workers who came from among the poorest Bute tenants in Glamorgan.(37) The Butes, were, through their wealth, initiative, and entrepreneurial ability, able to build an industrial empire in South Wales. It was not through direct management that they necessarily played their most significant part, but as instigators of industrial development through the provision of the means to exploit their Glamorgan estates.

Although some landowners did not take an active interest in the exploitation of their minerals, many were prepared to foster transport schemes to widen their coal markets and indirectly enable colliery rents to be raised. Lord Londonderry who owned collieries at Rainton and Pittington carried his coal to staithes at Penshaw on the Wear, after which it was transported to Sunderland, where it was reloaded onto sea-going vessels. Londonderry realised the potential of Seaham as an outlet for coal and after encouragement from John Buddle construction started in the 1820's with the inner harbour completed by July 1831. This brought the amount expended on Seaham Harbour between 1825 and 1831 to £162,000 and later a railway was added, along with over 100 houses for workers, which returned £5,000 in port tolls alone.(38) In Wales, Lord Plymouth, whilst withdrawing from mining, invested in the development of the Penarth and Barry docks. The intention to exploit their mineral resources on a more extensive scale was the main reason for the Duke of Bridgewater's Worsley canal and the harbour schemes of Lord Lonsdale and

Bute. The Leicester Navigation which gained its parliamentary assent in 1791, was supported by Lords Rawdon and Ferrers and Sir George Beaumont, whilst many of the early Leicestershire turnpikes were promoted by Lords Hastings and Stamford and the Beaumonts, and the importance of coal traffic can be seen in preferential rates given for waggons carrying coal.(39) On the other hand when transport schemes were not in the landowners' interest, they used their powers to put obstacles in the way. For example, the Bridgewater trustees led by R.N. Bradshaw, petitioned against the Liverpool to Manchester Railway Bill, until the latter was persuaded by Lord Strafford to withdraw his objections. Lord Durham and his agent Henry Morton opposed the South Durham Railway which threatened to benefit the Teeside collieries at the expense of their Wear collieries.(40)

The degree to which an estate was efficiently managed was dependent upon the active interest of the landowner and the professional ability of his agents. The Dudley estate expanded rapidly under the second Viscount in spite of profits and efficiency being adversely affected by the anachronistic managerial practises and the absence of long-term planning. Although this was a criticism that could be levelled at many great landowners they were pioneers in the field of industrial planning and management. During the period when the Dudley estate was held under trustees, between 1833 and 1845, it was fortunate in having the services of Edward Littleton, a trustee with business interests, and auditor James Loch, agent to the Duke of Sutherland, who brought considerable business acumen. At the higher managerial level, the efficiency and fortunes of a landed proprietors' colliery undertakings were dependent upon the expertise of their mineral agents. In 1797 Charles Beaumont was employed to replace a Mr Cockshutt, dismissed for incompetence, but who in turn was relieved of his position when his reorganisation created local unrest on the Dudley estate. The appointment of Downing as mineral agent in 1826 again saw profits and efficiency decline, and it was not until after the collieries came under the control of Richard Smith in 1836, that

profits and output improved. The major obstacle to efficient management on the Dudley estate, was the employment of agents, such as Downing, who did not have the necessary professional knowledge. The mineral agents usually performed further duties as land agent, and thus were unable to give their full attention to a rapidly developing mining enterprise. On the Dudley estate a partial solution was found by identifying areas of responsibility and designating these to specific sub-agents. In addition, there appears to have been a correlation between efficiency and the active involvement of the landowner for it was the second Viscount and his successor, for a few years, who were personally concerned with the estate's everyday administration. The third and fourth Viscounts were less involved in management, which it has been suggested, accounted for the level of inefficiency and corruption on the estate after 1800.(41)

The fluctuating fortunes of a mining enterprise, and the ability of its managers, is well illustrated in the Lowther's Whitehaven Colliery. During the early years of the eighteenth century, the Lowther mineral estate was developed through the business ability of the landowner, and mining expertise of Carlisle and James Spedding. This situation was dramatically reversed later under the management of a Mr Wigley, whose incompetence tolerated dishonesty and indiscipline among the workers, and as a consequence exports from the Whitehaven Colliery declined from 158,124 tons in 1788, to 90,628 tons by 1802. Although exports rose to 153,728 tons in 1803 under John Bateman, the slackness of the previous management was difficult to eradicate.(42) A lot depended on the expertise and dedication of estate agents, and it is not surprising that landowners were prepared to employ the relatives of those officials whom they found proficient, and so dynasties of viewers and agents could be found employed by a landed estate. On the Earl of Moira's estate, the land agent J. T. Woodhouse became a prominent civil and mining engineer, trained his brother-in-law and son as mine engineers, and later set up his own school of mining.(43)

The land agent on the great estates like the Earls of Durham, had to be particularly dedicated, hardworking, and knowledgeable, about all aspects of estate management, from arranging farm leases to ordering colliery equipment. It is not surprising that some agents were not up to the task, with resulting inefficiency and maladministration. Profits from the Earl of Durham's collieries, for example, slumped from £29,537 in 1820 to £6,405 in 1826, and on investigation it was found that the lack of proper book-keeping allowed colliery expenditure to go unchecked. On the appointment of Henry Morton, management was tightened up and by 1837 profits had reached £70,000.(44) Morton was the chief land agent to the Earls of Durham from the late 1820's to his death in 1870. Durham depended on Morton to manage the estate efficiently, and in his capacity as agent, he was successful in '... reducing extravagance, weeding out the inefficient and corrupt, and bringing their extensive concerns under a unified direction.'(45) The Durham estate also provides an example of where the efficient management of an estate depended on the attitude of the landowner, for even Morton found considerable difficulty in running the enterprise on a sound economic base with an owner described by Spring as '... stubborn, reckless, his head full of anything but pounds, shillings and pence.'(46) Eventually the Earl did settle down and take a more serious interest in estate affairs.

Although the second half of the eighteenth century was a period of direct involvement by the landed interest in the exploitation of their minerals, by 1830 the majority had reverted to the role of lessors and by 1869 only some five per cent of collieries in England were owned and managed by the landed proprietor. In the North-Eastern Coalfield the Lords Northumberland, Ravensworth, Strathmore, Wharncliffe, and baronet Ridley had withdrawn from direct management, and according to John Buddle, by 1829 only five out of forty-one owners directly worked their collieries on Tyneside, and three out of eighteen on Wearside.(47) The reasons for giving up direct control were varied and indeed some landowners continued to manage their collieries through-

out the nineteenth century. The rising cost of mining was a major factor as collieries were driven to greater depths, increasing the need to install expensive capital equipment with only the wealthy landowner able to sustain such levels of investment. In the Leicestershire coalfield adverse physical conditions witnessed the withdrawal of the landed interest from mining in the eighteenth century, with only the large landed proprietors such as the Earls Ferrers and Moira having the financial resources to retain direct control. As collieries were worked on a more extensive scale with complex techniques of mine engineering, the industry became more remote from the everyday experience of the landowner. Lord Scarbrough reflects this difficulty when writing that he could not decide on a course of action because '... this underground work, which it is not to be suppos'd I can understand', and in reference to the terms of a new lease: '... many of the Propositions are describ'd in such technical Terms (peculiar I suppose, to the Coal Trade) that you may imagine, I do not understand them but whenever I do, I perfectly approve of yr answers and where I am in the Dark as to particular Terms, I feel the fullest reliance on your Decisions.'(48) The landed proprietor came to rely on the expertise of viewers, mineral agents and mining consultants, and the expense of hiring their services probably deterred many of the gentry from managing their own collieries. The reliance of many landowners on their agents to prevent fraud, inefficiency and loss of revenue, also proved an important factor in determining the landowner to lease.(49) Members of the gentry with less wealth generally preferred to lease their mineral reserves as it was '... usually profitable, safe, and least distracting from the more reputable activities of a landed gentleman.'(50) As profits were a major factor in persevering with direct management, a fall or fluctuation in revenue could persuade the proprietor to lease and relieve themselves of the risks of enterprise. After 1795, for example, the presence of technical difficulties and a decline in profits encouraged the leasing of several limestone mines and quarries on the Dudley estate.

The factors determining the lesser landowners to directly manage or lease their collieries were probably less complex than those for the great landowner. In the former's case it was usually economic realities that overruled any philosophical considerations in relation to the exploitation of their mineral resources. Insufficient monetary returns did not justify the risks of direct management. In addition many of the lesser landowners did not have the financial resources to invest in mining enterprises that became increasingly more complex and capital intensive. It was more convenient and less demanding of estate resources to lease their minerals to others with the necessary capital and expertise. They were able to play an indirect role by providing the means to enable their minerals to be more easily exploited, especially through the encouragement of transport schemes.

For the great landowner economic considerations were not necessarily the only factor in deciding whether they directly managed or leased their collieries, as many landowners, such as the Butes, who had sufficient wealth, preferred to lease their minerals. There is no general factor applicable to the landed interest as a whole, For example, it has been suggested that the landowners in the North East directly controlled their mining enterprises because the income received from collieries was such a prominent proportion of total revenue, due to the poverty of the agricultural land. However, this cannot be used to explain why the Butes preferred to lease their minerals in South Wales where the land was equally unrewarding.

It would not be true to say there are no common factors that determined whether the landed interest managed or leased their collieries, but these are often influenced by factors that are specific to each landowner or locality. For example, in June 1836 the Earl of Durham was considering the sale of his collieries, but the idea was quickly dismissed when his agent, Henry Morton, believed the Stanhope Colliery Co., the prospective purchaser, would be unable to raise the capital and could thus be forced into the Court of Chancery.(51) Thus

the sheer size of an undertaking may have been sufficient to force a landed proprietor to continue with direct management following the lack of any entrepreneur with sufficient resources to take over the enterprise. A difference of opinion with an agent may in itself have persuaded a landowner to withdraw from the industry, for according to J.T.Ward, the 9th Earl of Mar with collieries in Alloa retired from direct management in 1835 after disagreement with Robert Bald's 'unpopular and puritanical paternalism.'(52) The individual character and philosophy of the landowner was of vital consequence to the degree of active interest shown in their enterprise, and the level of involvement determined the extent to which an estate's potential was realised. It was the capital and initiative of such proprietors as the 2nd Viscount Dudley and the 2nd Marquis of Bute with their desire to exploit their resources that led to the development of certain parts of the country. Even so, by the early years of the nineteenth century the majority of landed proprietors had reverted to the role of lessees. This was as a result of the rapidly increasing costs of mining on a large scale, fluctuating profits, technical and geological difficulties, and the increased complexity of mine engineering from which the landowner felt more remote, whilst the ability of a colliery enterprise to return appreciable profits also depended upon the conscientiousness and expertise of their agents and the interest shown by the landowner.

There were members of the landed interest who continued with direct involvement in mining throughout the nineteenth century. Such landowners usually had a personal interest and philosophy that pre-disposed them to take an active part in industrial management, although this was usually reinforced by an enterprise which returned substantial profits. In addition, control over several collieries did in some cases relieve them of the '... doubts and anxieties and watchings of the small capitalist in winning and working a small colliery ...'(53) The ability to expend large capital sums in the exploitation of their minerals was of paramount importance for the continued direct management and working of an enterprise. This was reflected by the

Earl of Durham who was able to purchase the Newbottle collieries for £70,000 in 1822, which compared with the total valuation of the stock and buildings at the Sheffield collieries of £9,297-8-4½ in 1820.(54) On the other hand the 7th Duke of Devonshire who had invested huge sums in the Furness district of Lancashire felt obliged to use further resources to keep his business concerns going during the years of economic depression after 1874. Although there was no common factor to explain why the landed interest should either directly manage or lease their concerns, it was mainly those who, in addition to having a personal interest in their concerns, occupied large estates with considerable capital resources, employed capable agents and whose concerns returned regular profits, who tended to retain direct control of their collieries.

Let us now turn to the Norfolks and Rockingham Fitzwilliams, to see how far they reflected the activities and personal involvement of the great landowners. Although they did not develop such extensive or varied industrial enterprises as a Dudley, Bute, Devonshire, Londonderry or Durham nor have such a profound influence on the economic development of their estates, they nevertheless did have a determining effect upon the industrialisation of South Yorkshire. It is by studying the exploitation of coal and the development of related occupations on the Sheffield and Wentworth estates that some idea can be seen of the degree to which their respective landowners contributed towards South Yorkshire's industrial expansion.

The discussion of other landowners referred to earlier in this chapter raise points that need to be studied to see where the Norfolks and Rockingham-Fitzwilliams fit into the South Yorkshire and national scene. Why did these landowners take on and continue with the direct management of their collieries when many others became lessees? Are there any common factors that explain why Norfolk eventually reverted to the role of lessor whilst Fitzwilliam continued in direct management? Could their estates be looked upon as an economic unit to be developed in unison with other estate activities and to what extent did

they provide the stimulus to the economic development of the area through land purchases, transport schemes and the encouragement of other industrial enterprises?

Other areas of study involve the degree to which Norfolk and the Rockingham-Fitzwilliams were leaders in the introduction and promotion of technological innovations, by the provision of capital for the large-scale development of mining and movement of coal. As with many great landed estates the expansion, efficiency and profitability of an industrial enterprise often depended upon the individual motivation and personal interest shown by the landowner, the professional competence of senior management, and the modification of accounting management practices. These areas too must be considered to assist in the better understanding of the landowner and his industrial enterprise. It is by doing this that a greater understanding may be acquired, not only of the contribution of the Norfolks and Rockingham-Fitzwilliams to mining in South Yorkshire, but also of their place among the landed interest as a whole in the industrialisation of the British economy.

CHAPTER TWO

The Norfolk and Rockingham-Fitzwilliam Families in South Yorkshire

The Norfolks began their association with South Yorkshire on the marriage of Thomas Howard to Lady Alethea, the co-heir and daughter of Gilbert, 7th Earl of Shrewsbury. It was from this marriage that the Sheffield estate descended to the Howard family in 1605. Soon after James I ascended the throne, Thomas Howard regained favour with the crown and recovered the Earldoms of Arundel and Surrey which the Catholic Howards had lost in the course of the religious disputes of the sixteenth century. A large proportion of the former possessions of the family was also restored. In 1621 Thomas was given the position of Earl Marshal of England and in 1644 was created Earl of Norfolk, although the Dukedom was not restored until 1664.(1)

Many of the Howards were Roman Catholics, and as such were unable to carry out their duties as Earl Marshal or sit in the House of Lords until the Emancipation Act in 1829. Instead the 9th Duke spent much of his time building Norfolk House in St. James' Square, London, and rebuilding Worksop Manor, the ancient seat of the Earls of Shrewsbury.(2) As the Sheffield estate did not contain a family seat, the Howards appear not to have taken such a personal interest in its development. This is in contrast to the attention they paid to the Arundel estate in Sussex.

On the death of Edward, 9th Duke of Norfolk in 1777 aged 91 years, the eldest branch of the family became extinct, along with the Earldom of Norwich and the Barony of Howard of Castle Rising. The Dukedom was inherited by Duke Edward's second cousin, Charles of Greystoke, but under a settlement of 1767 the Sheffield estate was placed under trustees, and although Charles succeeded to the titles, it was his son who received the profits of the Sheffield and much of the Sussex estates.(3) As a Roman

THE NORFOLK FAMILY

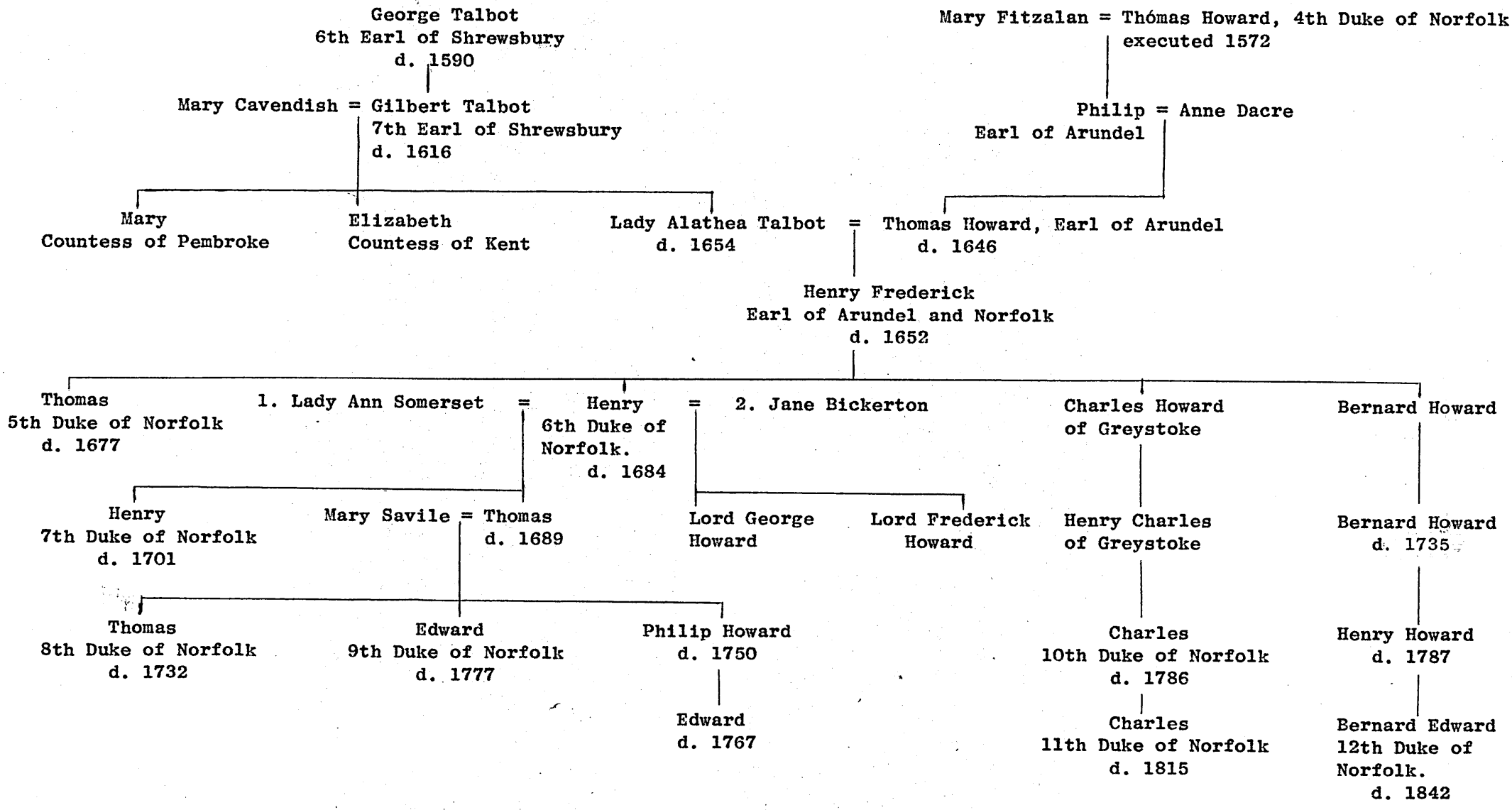


Fig. 1 Source: Catalogue of the Arundel Castle Manuscripts (Sheffield City Libraries) p.8.

Catholic the 10th Duke was unable to take his seat in the House of Lords, and instead spent much of his time at Deep Dene, near Dorking, where he died aged 65 years on 31 August 1786. Therefore it was unlikely that the Duke paid much attention to the Sheffield estate. Instead he left its management to the trustees and the Earl of Surrey. Even so the period from 1777-1786 was not one of inactivity, for in 1781 the Sheffield collieries were placed under direct management and with it commenced a major programme of capital investment.

The 11th Duke was educated at the English College in Douai, became a member of the Church of England, and entered the House of Commons for Carlisle where he supported the Whigs. On 30 August 1782, he was created Deputy Earl Marshal, and between 1782-98 held the position of Lord Lieutenant of the West Riding of Yorkshire. Further titles included Lord of the Treasury April-December 1783, Provincial Grand Master of the Herefordshire Freemasons 1789-90 and President of the Society of Arts from 1793 until his death in 1815. But, after an indiscretion in a toast to the King at a political dinner attended by nearly 2,000 guests, he was deprived of all his political offices.(4) During this period Norfolk turned his attention to the extension of his Sussex estates and the rebuilding of Arundel Castle, and it was to further these activities that the 11th Duke was given parliamentary permission to sell some of his Sheffield property in 1802.

> '...for vesting several messuages and hereditaments in Sheffield and divers detached parts of the settled estates of the most noble Charles Duke of Norfolk,in trustees upon trust to sell, and for laying out the monies in the purchase of more convenient estate and otherwise.'(5)

After the death of the 11th Duke, his third cousin Bernard Edward, whose father was Henry Howard of Sheffield and Glossop, succeeded to the

Dukedom, to become the first Sheffield-born Howard to inherit the title and estates. With the passing of the Roman Catholic Relief Bill in 1829, he was able to take his seat in the House of Lords, and become a member of the Privy Council, from where he supported the Whigs and the Reform Bill.

The Sheffield estates of the Dukes of Norfolk contained approximately 20,000 acres of which 8,000 acres was moorland. In addition, they had estates in eight other counties approaching 49,866 acres, producing a total rental during the 12th Duke's occupation of £75,596 of which the Sheffield estate contributed £39,897. The Sheffield estate was the most valuable part of the Norfolk property, returning an annual rental in 1799 of £16,873, rising to £18,000 in 1815 and £30,759 by 1866, with markets and fairs adding a further £7,682. Rents were received from land, cutlers wheels, ironworks and minerals with the last item alone contributing £14,286 by 1866. These Rents more than doubled under the management of Michael Ellison who was appointed land agent to the Sheffield estate in 1819, and it was the income from the coalmines and steelworks of Sheffield that according to Ward 'buttressed' the Arundel estates in Sussex.(6)

It is difficult to ascertain how active the Norfolks were in the management of the Sheffield estate as few letters remain from the period under study. However, they were concerned for the welfare of the town and its population. During the winter of 1769 the 9th Duke gave £40 to the poor, and in the harsh winter of 1795 the 11th Duke donated coal to the value of £185.(7) Certainly from the 12th Duke onwards, the Norfolk family took a personal interest in the welfare of the town, although they would have seen the possibility of acquiring additional revenue from its rapid industrial expansion and rising population. The 12th Duke for example, assisted the development of Sheffield, and raised his own rental

by leasing for 99 years large parts of the estate's town property. City centre public improvements were made at the Duke's expense, including the bridge over the River Don, costing £4,000, a new post office, exchange rooms, and alterations to the market buildings under estate management, to a total cost of £50-60,000.(8)

The Rockingham-Fitzwilliam Family

We now turn to our second landed family, the Rockingham-Fitzwilliams. To understand the history of this family we have to go back to the 2nd Earl of Strafford, who died without issue. The estate therefore passed to Thomas Watson-Wentworth, a son of the 2nd Earl's eldest sister, who married Edward Watson, 2nd baron Rockingham. On the death of Thomas in 1723, the estates were inherited by another Thomas Watson-Wentworth who was created Marquis of Rockingham in 1746. He died in 1750 when the estates passed to Charles Watson-Wentworth. On his death in 1782, there was again no direct male heir. As a result, the estates passed to William, Earl Fitzwilliam son of the Marquis's oldest daughter who had married the 3rd Earl Fitzwilliam of Milton in Northamptonshire, an old established landed family.

William Wentworth Fitzwilliam, Earl Fitzwilliam, was 34 when he inherited his uncle's estates. These included 20,000 acres in Yorkshire, 80,000 acres in Ireland and 24,000 acres in Northamptonshire and Huntingdonshire. On the death of the Dowager Marchioness in 1804, property at Badsworth, Billingley and Ecclesall also came into his possession. The major residence in Yorkshire was at Wentworth, a large Palladian mansion set in a park of 1,500 acres. The Yorkshire seat of Wentworth Woodhouse dates back to the seventeenth century, and built in the style of Inigo Jones, with later additions added in 1725 and 1734. Soon after inheriting his uncle's estates the 4th Earl employed John Carr of York to add a third floor to the house and with the extensive stable block that housed hunting and racing horses the estate could boast one of the best hunts in the country

THE OWNERS OF WENTWORTH WOODHOUSE

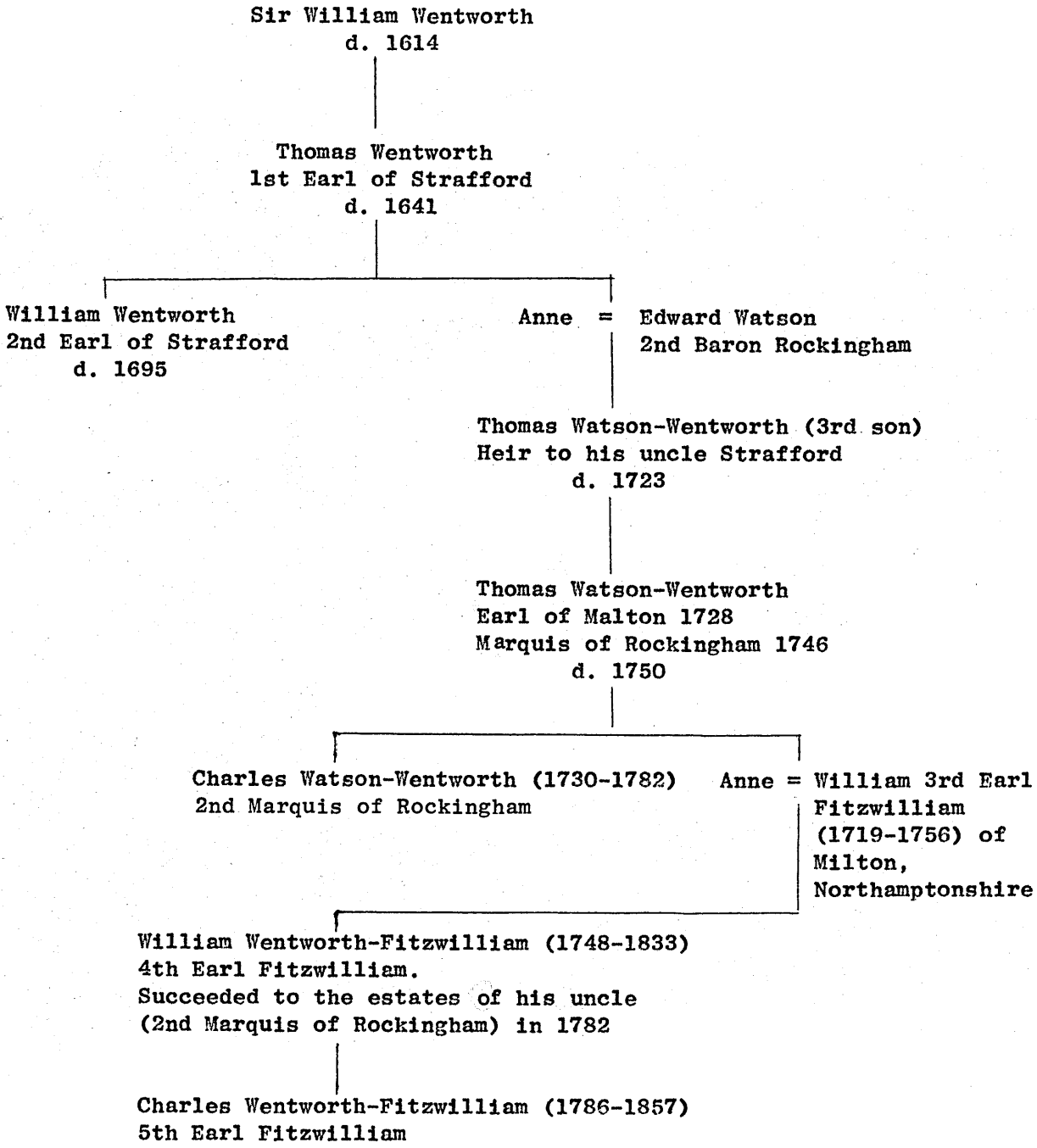


Fig. 11

Source: Wentworth Woodhouse Muniments, Summary Lists, (Sheffield City Libraries) p.1.

in the early nineteenth century.[9]

It was customary for men of Fitzwilliam's wealth and status to entertain on a lavish scale and when George, the Prince of Wales, visited Wentworth in 1789, a fete was held for 20,000 guests. In 1807 on Lord Milton attaining his majority, a feast was given in Wentworth Park at which the tenants were dined in the house, whilst in front of the house two oxen were roasted for those present. Cold meat and bread were served on the terrace, with the liquor held in mangers or troughs, and the Earl, who could not be there, was to give a ball for the 'ladies and gentlemen' when he came down in the autumn.[10]

Lord Milton inherited the estate on the death of his father in 1833, although for many years previously he had assisted in management but with the final policy decisions left to the Earl. Before inheriting the Earldom Milton had been a member of the House of Commons for 27 years, a position not held without considerable expense as in 1807 when the family spent £98,614 in contesting the County of York seat with Henry Lascelles. He supported the Reform Bill, advocating the non-payment of taxes until it was passed, sided with the industrial interests of the West Riding and was the first substantial landowner to oppose the Corn Laws in the Commons.[11] Milton took a keen interest in technical and commercial matters, becoming the first president of the British Association for the Advancement of Science in 1831, was elected as a Fellow of the Royal Society and president of the Statistical Society. Among the technical and engineering literature he read, was Playfair's Outlines of Natural Philosophy and Tredgold's The Steam Engine, the latter enabled him for the first time to understand the working of the steam engine. The 5th Earl's technical knowledge was used in the management of his industrial concerns allowing him to carry on discussions with his Wentworth agents on such matters as sinking a new pit, the types of wheels for coal waggons and calculations concerning stresses on beams used on railways.[12]

As a wealthy landowner the 5th Earl believed that life should be spent usefully in the pursuit of knowledge and self-improvement, describing landlords in his diary as '...pensioners upon the industry of their tenants', and the rich as '...pensioners upon the industry of the poor'.(13) Although not supporting democratic trends, the 5th Earl like his father, thought the landed interest had certain duties to their tenants and workers. The Fitzwilliams showed a paternalistic attitude towards their employees, in providing schools, pensions, injury allowances and provisions during times of depression and high prices. In June 1787 for example, the 4th Earl, in writing to his Household Steward at Wentworth, suggested that to prevent the spread of smallpox in Greasbrough, the inhabitants there and at Wentworth, Cortworth, and Haugh ought to be innoculated, and if need be, at his own expense. During the winter of 1799-1800 when grain prices were high, the Earl showed an example by rationing the consumption of bread and beer by his family at Wentworth. This was no mere gesture for in March 1800 he strongly rebuked the 'House' for the quantity of wheat consumed. He did not think it correct for the poor to see bread used 'wantonly' when many were without, believing the family should show the population an example of 'denial' and 'forebearance'. In 1801, the Earl provided rice and herrings at reduced prices, in addition to blankets for the poor at Wentworth, Milton, and Higham Ferrers.(14)

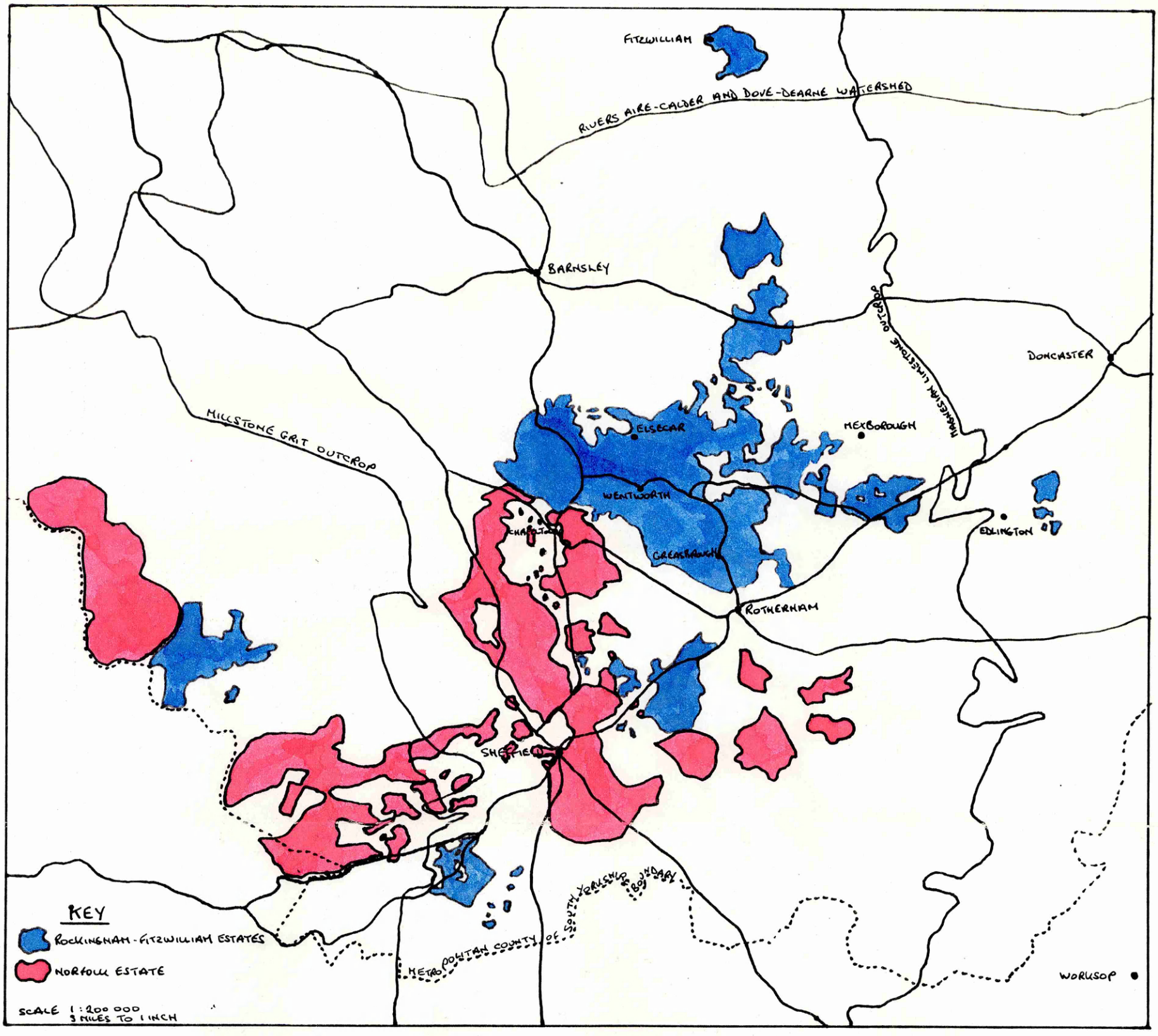


Fig. III. THE SOUTH YORKSHIRE ESTATES OF THE NORFOLK, ROCKINGHAM, AND FITZWILLIAM FAMILIES 1800.

The Geography of the South Yorkshire Coalfield

The South Yorkshire coalfield extends from Wakefield in the north to Sheffield in the south, a distance of approximately 25 miles, and some 20 miles wide from west to east. It forms part of the much larger Yorkshire, Derbyshire and Nottinghamshire coalfield, which extends 60 miles from Leeds to Nottingham. The study covers that area which is commonly referred to as the 'exposed coalfield' with its western boundary formed by the millstone grit of the Pennine Chain, following a line from Huddersfield through Holmfirth, Langsett, Stocksbridge, Oughtibridge, Bradfield, Crookes and Whirlow, to the present South Yorkshire county boundary. The northern limit is taken as the watershed that divides the Don and Dearne drainage areas from the Aire and Calder rivers. Whilst to the east the boundary conforms to the Lower Magnesian Limestone escarpment extending from South Elmsall, Hooton Pagnell, High Melton, Conisbrough, Maltby and North Anston to the county perimeter. There is no natural geographical boundary to the south; therefore, the South Yorkshire County line has been taken for the purpose of this study. Within these boundaries, the exposed coalfield covers an area of approximately 290 square miles.

The major rivers traversing the coalfield are the Don, Dearne and Rother, but prior to 1800 it was the lack of navigable waterways that limited the development of the coalfield, for the Don itself was made navigable as far as Tinsley, some three miles from Sheffield, only in 1751. The opening of the Don Navigation stimulated the development of large-scale collieries close to the waterway, but those located further from the Navigation continued to be worked on a small scale until the Dearne valley was made navigable from Swinton to Barnsley by the Dearne and Dove Canal in 1804.(15)

The coalfield was dominated by the three towns of Barnsley, Rotherham, and Sheffield, with the intervening topography reflecting a pastoral scene. On his tour of the northern counties in 1769, Arthur Young noted that:

> 'The country between Sheffield and Barnsley is fine; it abounds with the beauties of landscape, and has a pleasing variety', and 'Wentworth house, the palace of the Marquis of Rockingham, is situated between Rotherham and Barnsley, in the midst of a most beautiful Country, and a park that is one of the most exquisite spots in the world'.(16)

Even after considerable coal and ironstone mining, J. T. Jeffcock was able to write of the area north of Sheffield, around Chapeltown, in the following terms:

> 'Those who can recollect the South Yorkshire roads before railways had changed the course of traffic, may remember the striking view which met them on the way from Rotherham to Wortley, as they left bleak Thorp Common, and began to go down the hill-side clothed with the old woods of Hesley Park. In front rose the dark fir-covered bluff of Grenowood Head; nearer to them, the green rounded hill of Hunshelf swelled on and sank on their left to meet the Knoll on which the Parish Church of Ecclesfield stands, while deep down in the grassy meadows below them ran the Blackburn Dyke; from an eminence above which, and quite in the foreground of the picture looked up the quaint chimneys, roofs and casements of Cowley Manor'.(17)

Although by the late twentieth century the area between Wakefield and Sheffield is marked by extensive coal and ironstone workings, factories and sprawling suburbs, there are some large expanses of open country which give an impression of what it was like in the eighteenth century. The countryside around Barnsley as late as 1947 for example, was described as:

> '...pleasant rolling scenery marked by escarpments and dip-slopes of sandstone, and the country is essentially pastoral in character'.(18)

The most productive coal beds were found in the Middle Coal Measures lying between the River Dearne in the north and the River Don to the south, where the three major seams, the Barnsley, Parkgate, and Silkstone outcropped. In the Sheffield area the coal measures reached the surface in a north-south direction within a 12 mile band containing between 80 and 100 coal seams although many were very thin and limited laterally. However, some 27 seams, largely of the bitumous variety, have been worked in the Sheffield area, even though many contained dirt partings of 'seatearth', shale or shaly coal.

The grain of the coal measures, for the coalfield as a whole, was determined by a general north-west strike of the rocks, the only exception being a narrow belt under the influence of the Don Monocline running from Rotherham to near Fulwood on the south-west side of Sheffield, where there is a north-east alignment. Dipping gently to the east, the coal seams exhibited few faults, except in the Don valley between Rotherham and Sheffield, and over the area as a whole the coal seams maintained a reasonable degree of constancy, in thickness and physical characteristics. Each seam consisted of a number of layers of one or more varieties of hard, soft, bright or 'cannel' coal, which often contained partings or bands of dirt, but the various types of coal which were mined, covered the whole range of steam, manufacturing, house, gas, and coking coals.(19)

The Barnsley coal seam was worked initially along its outcrop, the name being taken from the town that saw some of the seam's early workings.(20) The seam outcropped at Far Moor House and ran through Darton, Gawber and Barnsley before striking southwards, where it was frequently broken by faulting, especially between Worsbrough reservoir and the south-west of Elsecar. From Elsecar the seam ran in a south-east direction through Wentworth Park, Nether Haugh and Rotherham where it followed the Don valley to Attercliffe, before striking out in a south-east line through Handsworth.

The coal dipped generally to the north-east at a gradient of 1 in 3 at its outcrop, but eventually declined to 1 in 40. Apart from the faults that occurred between Worsbrough and Elsecar, the most pronounced faulting lay along the Don valley, which seriously disrupted working the coal and raised production costs.(21)

Part of the Barnsley seam contained hard or semi-anthracitic coal, especially suitable for locomotives, steamers, and iron smelting, being judged in the Admiralty trials of 1849, as equal to the best Welsh and Newcastle coal.(22) The hard coal occurred in the middle of the bed, whilst the upper and lower sections were comprised of soft coal, suited for household use. To the south-east of Sheffield its thickness varied between 4 feet and 4 feet 6 inches, containing 1 foot 9 inches to 3 feet 6 inches of hard coal whilst to the north the seam continued to Darton before running out.(23)

Lying at a depth of approximately 840 feet below the Barnsley seam was the Parkgate coal, whose name was originally taken from a farm called Park Gate, situated at Thorpe Common on the road from Rotherham to Chapeltown, but later named Kirkstead Abbey Grange.(24) The seam followed a similar line to the Silkstone outcrop at 1 to ½ mile distance, running from the west of High Hoyland through Stainborough Fold, Westwood, Chapeltown, Thorpe Common, Rotherham, and then south-west to Sheffield, before swinging to the south-east, in line with the Barnsley seam. In thickness the coal varied between 4 to 6 feet, comprising of three parts - bottoms, hards or middle coal, and tops. Bottoms and tops were bright coals suitable for gas making, household use and coke, whilst the hards provided steam coal.(25)

The third major bed of the South Yorkshire coalfield was the Silkstone coal, located some 300 feet below the Parkgate seam.(26) It outcropped

along a south and south-east line from Skelmanthorpe through Cawthorne, Silkstone, Eastfield, Bromley, High Green, Chapeltown, and Kimberworth before turning south-west to Sheffield, then again, south-east to Gleadless. As far north as Cawthorne the bed maintained a fairly constant character with an average thickness of 5 feet, consisting of two beds of coal separated by a dirt parting. The upper bed had an average thickness of 2 feet 6 inches, whilst the lower bed was 2 feet, with a dirt parting varying between 1 inch to 1 foot. However, between Kimberworth and Chapeltown the dirt parting swelled out to 30 feet and at Thorpe Common reached 35 feet. The Silkstone seam was of very high quality and ideal for household coal with the 'smalls' converted into coke of 'excellent quality', and as such was extensively worked in the Sheffield, Chapeltown, Thorncliffe, Pilley, Mortomley and Silkstone areas.(27)

Although the Barnsley, Parkgate, and Silkstone seams were the major beds worked in the South Yorkshire coalfield, other coal was mined. The High Hazles or Kent's Thick coal, approximately 3 to 4 feet thick, was mined particularly around Sheffield, whilst the Fenton's Thin seam consisting of several thin coals with dirt and shale partings and outcropping at High Green, contained in its main parting a valuable ironstone measure called the Black Mine. A further coal, the Thorncliffe Thin, outcropped from Wortley Park through Westwood and Chapeltown, and was mainly worked at Thorncliffe and Pilley.(28)

The presence of ironstone in the South Yorkshire coalfield facilitated the development of the coal industry as the ironstone seams occurred between the Barnsley and Silkstone beds and included the Tankersley, Claywood, Black, White, and Yellow ironstone. Located some 12 yards above the Silkstone coal, the Claywood ironstone consisted of 6 feet or more of black shale with layers of nodules and thin bands of clay iron-

stone with a yield per acre said to have been between 1,500 to 1,600 tons of ore.[29] One of the richest ironstones in the area was the Tankersley ironstone found a few feet above the Flockton coal. The seam yielded, on average, approximately 2,000 tons per acre, and worked essentially where it outcropped in the Cawthorne and Tankersley areas and used extensively in the Thorncliffe, Milton and Elsecar ironworks.[30] In the main parting of the Fenton coal was found the Black Mine Ironstone, mined largely to the north-east of Chapeltown in Hesley Park Wood and with the Thorncliffe Black and White Mines, supplied the ironworks at Thorncliffe and Parkgate. The Swallow Wood ironstone was mined at Milton, and also worked extensively with the Lidgate mine at Tankersley and Thorncliffe.[31] It was the close proximity of the ironstone to the coal seams that provided an additional stimulus to mining development and the establishment of ironworks at Sheffield, Chapeltown, Elsecar, and Rotherham. Two other minerals found in South Yorkshire - clay and limestone - helped to stimulate the market for coal with the former used in the manufacture of pots, bricks and tiles, whilst limestone was burnt and used increasingly for agriculture and iron smelting.

The physical characteristics of the coal seams aided their exploitation, for as the seams outcropped in the area with considerable conformity and proximity to each other, they did not produce the problems associated with deeper coal of ventilation, drainage, and haulage. It was not until the middle of the nineteenth century, when collieries were working at far greater depths, that serious difficulties arose. For instance, by 1866 the Oaks Colliery near Barnsley, was working the Barnsley seam at a depth of 285 yards when it experienced several explosions, killing over 300 men and boys. These early physical advantages and the concentration of land in relatively few hands, reduced the need for underground and surface wayleaves or the purchase of freehold coal at exorbitant prices, which assisted the large-scale working of the coal measures.[32] Once the prob-

lems associated with transport had been overcome, the coalfield was able to develop apace until, by the twentieth-century, it has become the premier coal producing area in the United Kingdom.

Coal Mining in South Yorkshire before 1750

The earliest documentary evidence of mining in South Yorkshire refers to the activities of religious houses which were largely concerned with the working of ironstone for their numerous forges, but would have used coal in some of the metallurgical processes. During the twelfth century the religious houses of Byland and Rievaulx worked ironstone at Flockton, Emley and Denby and the monks of Kirkstead in Lincolnshire had ironworks at Kimberworth and Cortworth around 1160. Brierly coal was worked about 1396, by the Augustinian canons at Nostell Priory near Wakefield, and in 1491 Cluniac monks of St. John's Priory, Pontefract, acquired a coal pit in Barnsley.(33)

Coal mining was not only the reserve of the religious orders. This was evident in 1369 when Thomas de Brerlay del Strete of Cortworth near Wentworth granted a coal mine there to Sir John Fitzwilliam.(34) The same Sir John received from Pers del Strete, in 1373, all the coal in a rood of land in Cortworth adjoining his property. An Edmund Fitzwilliam gained confirmation in 1388 of a grant of all the 'mine' beneath two acres of land at Nether Haugh near Wentworth, from John Paldeyne of Rotherham, and thus the Fitzwilliam family were mining coal in the neighbourhood of Wentworth from at least the mid-fourteenth century.(35)

The Fitzwilliams, in common with other landowners, leased their coal reserves, for it was not until the eighteenth century that the landed interest were to manage their own collieries on any considerable scale. Sir John Fitzwilliam leased for 30 years in 1370 a coal mine to be worked

by three 'picks', to Thomas Tay, Robert de Denby and Robert Benet. At the same time he leased another pit for 30 years using three 'picks' in Cortworth, to John Hert and John de Morelay. A typical fifteenth century lease is shown by the following, granted on 15 May 1486, for a coal pit at Cortworth:

> 'Demise by Sir. Thos. Fitzwilliam, Knt., to Thos. Yold, Will. Kent and John Hyll of his coal pit "now at new thyreled" in the field of Corteworth from St. Dunstan's day for 5 years for £9-6-8d rent. The lessees may only use 3 picks, one barrow-man and one bank-man except the first year when they may have two barrow-men. They shall keep "inthyreled a ribbe called in to waste with due purgyng and clensyng of the seid myne and in dryffyng any depe hed into other with poste and thyrle at the water may lyghtly avoid". They shall also deliver to Sir Thomas on pit-bank three loads of coals yearly. 15 May, 1486.'(36)

The early workings exploited the Barnsley seam along its outcrop, which by the late fifteenth century had developed beyond the 'day hole' or 'bell pit' stage to more extensive underground workings, involving a form of pillar and stall method of extraction with a rudimentary system of drainage.(37) This method of working was very inefficient as leaving pillars meant that no more than 50 per cent of coal could be extracted, although the shallowness and limited extent of the mine workings did mean that the coal could be exploited with the minimum of capital expenditure.

The sixteenth and seventeenth centuries saw an expansion in the scale of coal mining in certain areas, with deeper shafts, more extensive workings and greater use of soughs for drainage, to take advantage of the increased demand for coal. The greatest impact upon the coal industry during this period was not from the introduction of technical innovations, but from the increased use of coal in those industrial processes that had

previously relied on wood. Coal was adopted for use in lime burning and salt panning, in the manufacture of tiles, bricks, glass and pottery, and in the growing number of forges. It was the Northumberland and Durham coalfield, with access to water-borne transport, that was able to take full advantage of these new markets and as a consequence, could attract the necessary capital to exploit the coal deposits on a larger scale than elsewhere in the country.

The inland coalfields were still retarded from working their collieries on a more extensive scale by poor roads, unnavigable rivers and the resulting high cost of transport. The Earl of Shrewsbury mined coal on his Sheffield estate at Handsworth, Gleadless, Dronfield and Sheffield Park but the small scale of working is noted by Stone in his study of the Sheffield Park pits between July 1579-December 1582. The average number of workers was five, producing an output that varied between 1304½ loads (1174 tons) and 1515 loads (1363 tons) per annum or approximately one-fifteenth of the output of a large-scale mine. Although the pit was relatively shallow, being 8 yards to the bassett and 22 yards to the deep level, it was typical of many collieries at that time in experiencing serious drainage problems. An inflow of water that interrupted work on a new pit being sunk was solved only at a considerable expense by men using buckets in relays.(38) The use of a sough did reflect an advance in mining technique and scale of operation at the Sheffield Park pits, but the shallowness of the workings still made it more cost effective to use a pit for only 2 to 3 years and then sink a new one, than to extend the underground workings. More extensive workings meant higher rates for the barrowers who were paid according to the distance their corves were hauled, in addition to new headings and props which were expensive items of expenditure.(39)

The Sheffield Park pits during the sixteenth century began to show that division of labour and specialisation which reflected mining on a larger scale. Pickmen were employed to hew the coal from the 'face', barrowers for transporting the coal to the shaft bottom with a banksman on the surface to stack and sell the coal and keep the accounts. Even so the pits had frequent official holidays that reduced the possible working days to 280, and with absenteeism it meant the pit lay unworked for a large part of the year. As the pickmen and barrowers received wages below the level of subsistence, mining was probably a part-time occupation supplemented by earnings from labouring or cultivation of small-holdings.(40) Mining was often a seasonable activity, and for many inland coalfields it remained so until well into the eighteenth century. It was not uncommon for mines to lay unworked during the winter months due to flooding and impassable roads, and even as late as the 1760's the Marquis of Rockingham's Elsecar colliers could be seen employed in thatching, hay making or ditching.(41) The busiest times of the year were during May and the Autumn months when labour and carts were available after the harvest.

During the seventeenth century the expansion of the iron industry in South Yorkshire stimulated the exploitation of coal as reflected by the more extensive working of coal in and around Sheffield, following the growth in the cutlery and fine-edged tool industry. In 1635 the Handsworth Park Pits were leased for 40 years at a rental of £60 per annum, and by 1656 produced 1600 loads (1440 tons) of coal, although the Sheffield Park Pits which were limited to 10 hewers in 1692 were probably the largest in the area.(42) The increased local market and the low capital cost involved in these shallow mines, allowed entrepreneurs such as yeomen, merchants, lawyers and ironmasters to participate in the extraction of coal. At Crookes, gannister was mined towards the end of the seventeenth century, by Henry Bromehead, a yeoman of Fulwood and two lawyers Thomas Chappell

and Joseph Banks, who had been agents to the Duke of Norfolk. These men paid an annual rental of £40 plus one-fifth of the profits. On the west side of Sheffield, Stephen Bright of Carbrooke, one of the leading merchants of the town, leased coal in 1635 from Lady Grace Cavendish at £66 per annum, and to the north of Sheffield coal was mined at Mortomley and White Lane near Chapeltown for local consumption.(43)

At Kimberworth and Whiston in the Don valley, two collieries on the Earl of Effingham's estate were worked during the 'Commonwealth' at respective annual rentals of £100 and £55 by Lionel Copley, an ironmaster. Coal under Crown property on Barnsley moor was leased in 1676 to the Honourable Sydney Wortley who sub-let at £40 per annum to Valentine Hurt of Ecclesfield. Thomas Townend of Upper Hoyland in a will dated 1632, bequeathed Stead Farm on Hoyland Common to his younger son Thomas, and to his heir Richard, the right to sink, dig and make a sough or drain a coal mine on the same land.(44) The Earl of Strafford in 1663 leased his Worsbrough pits whilst in 1693, Abraham Rock was paying £17 per annum for 'Coal-pit Close' on Keresforth Farm near Barnsley. In the parish of Silkstone, Robert Thwaites was working coal pits on Skiers Moor, and a 60 year lease was granted to Robert Walker of London, a merchant, and Daniel and William Walker of Rockley Old Hall.(45) As early as 1607, an indenture was made between Sawyer and Roger Elmhirst of London, 'gentleman' and Robert Swift and Robert Greaves both of Silkstone, to lease iron mills with the right to work and dig for ironstone and coal in fields called 'Coal Pit Close' and 'Iron Pitts'.

As pits became more extensive, capital costs correspondingly increased. This was reflected in the Handsworth pits worked by Sir John Bright who had to construct a sough costing £265 in a concern that was valued at £1800 in 1651. Deeper workings increased the problem of ventilation that was partially overcome at Handsworth by the installation of wooden pipes through

which air was forced with the aid of bellows. Natural ventilation may also have been used, whereby pits were sunk on the bassett and deep levels, with a change in atmospheric pressure affecting a movement of air. However, the use of fire baskets suspended in the shaft were in use in north Derbyshire at this time. In 1697, for example, the Heath colliery, belonging to the Duke of Devonshire, had installed a fire pan.(46)

The eighteenth century witnessed a further advance in the number of collieries sunk, technological innovations, depth of workings and a widening of the market for coal. This expansion was particularly marked after 1750, following the widespread adoption of coke in the iron industry, and the use of cheaper and more reliable forms of transport brought about by turnpikes and canals.

The area in South Yorkshire which saw the greatest exploitation of coal during the eighteenth century was formed by a triangle, contained within the towns of Barnsley, Sheffield and Rotherham. The rising population, with Sheffield in particular experiencing a rapid increase from approximately 6,000 at the beginning of the century to 10,000 by 1725, increased the domestic market for coal. The continuing expansion of the cutlery industry also raised the demand for Sheffield coal. This was reflected in the more extensive colliery workings and higher rentals. In 1737 John Bowden of Beighton leased from the Duke of Norfolk, pits in the parish of Sheffield, the Park, and on the Attercliffe and Darnall Commons for an annual rent of £400 plus one-fifth of all the coals worked in excess of a stipulated amount.(47) A further stimulus to the demand for coal was given in 1742 following the success obtained by Benjamin Huntsman in the use of coke for the production of cast steel.(48)

By 1730 coal from South Yorkshire was competing with that from Durham, in the Humber estuary and the valleys of the Trent and Ouse. Further consolidation of these markets was achieved with the opening of the

Don Navigation in 1751, linking the Humber estuary to Tinsley, some three miles from Sheffield, giving an easier access to Hull for coal and iron goods. The Don Navigation led to the expansion of coal mining along the Don valley where the waterway cut through the coal measures, and this resulted in the rise of colliery rentals in the Greasbrough area. John Hirst, for example, leased two collieries on the Wentworth estate at Swinton and Greasbrough in 1723, for a combined rent of £200 per annum; whilst the Navigation encouraged Thomas and William Fenton to open a major colliery at Basingthorpe in 1757 at £324 for each of the initial two years and £648 per annum for the remaining nineteen years.(49) This colliery was closely followed by further sinkings in 1758 on Mosbrough Common and the Holmes near Rotherham by Walkers & Co., to provide coal for their recently built ironworks. Walkers & Co. leased the Swallow Wood and Barnsley seams of coal from the Earl of Effingham, in addition to Tankersley ironstone. Other collieries in the area included the Old Parkgate working before 1764 and Southwell where coal was mined at least from 1765, whilst to the north-west of Holmes, coal was being extensively worked at Blackburn, Bradgate and Kimberworth.

Another centre of mining activity was in the vicinity of Elsecar, some 4½ miles to the south-east of Barnsley, but the distance from the Don Navigation retarded the development of the collieries until the opening of the Dearne and Dove canal in 1798. The Elsecar Colliery in 1760, for example, still employed only nine workers whilst across the Elsecar valley the Lowwood Colliery was leased in 1723 to Swallow and Wharam at only £35 per annum.(50) Of the two collieries the latter was always worked on a larger scale between 1751-97 due to its closer proximity to the Don Navigation. In 1737 the Earl of Malton granted a further lease of the Lowwood Colliery to William Spencer and Richard Bingley, who was later to become the sole lessee, at an increased annual rental of £124.19.0 based on £17.17.0. per collier.(51)

In Chapeltown, the Chapel furnace worked coal and ironstone in the Hesley, Parkin and Smithy woods belonging to the Duke of Norfolk. The Elmhirsts in Worsbrough were mining coal from the early years of the eighteenth century at Ouslethwaite in addition to pits owned by the Rock family, and coal was still being worked in Silkstone and on Barnsley Moor. In 1715 a colliery was opened on Wath Common with three collieries working on Swinton Common at the same time. A colliery was being worked at West Melton in 1725, and in 1745 a Swinton mine was supplying the Rockingham Pottery.(52) It can be seen that by the early eighteenth century, coal was being mined in those areas that were to see a major expansion in the exploitation of coal by the end of the century.

Some of the early colliery proprietors acquired sufficient wealth to purchase land and join the gentry. John Bowden was one such entrepreneur, who worked collieries on the Wentworth and Norfolk estates, the Portland property at Shuttleworth, the Duke of Leeds' estate at Todwick and on the Duke of Devonshire land at Beightonfield, Hollingwood, and Inkersall in Stavely. Revenue from mining allowed him to purchase considerable property in Clowne where he built Southgate House. Others who rose to the ranks of the gentry were the Staceys, Nodders and Fentons. The latter family acquired the lease of Rothwell Haigh colliery from at least the 1730's, and were able to build a coal empire with collieries in Yorkshire, Leicestershire, Derbyshire and Nottinghamshire in addition to rope, glass, iron works and copper mines.(53)

Mining techniques changed little in the South Yorkshire coalfield before 1750. Collieries remained relatively shallow, and therefore it was still cheaper to sink a new shaft than to extend the workings in comparison to the average depth of collieries in the Northumberland and Durham coalfield of 200 feet.(54) The shallowness of the South Yorkshire collieries and limited underground workings did not, however, necessitate

large capital expenditure as the Newcomen pumping engine was not introduced on any large scale until the last quarter of the century. Another feature of the inland coalfields was the limited number of employees, with few collieries employing more than 12 workers, whereas in the Northumberland and Durham coalfield, 40 was the average.(55) The Elsecar colliery, as late as 1769, for example, employed only nine workers.

The period from 1750-1830 saw coal mining carried out on an increasing scale, in response to a change in market conditions. War raised the demand for iron goods through government munition orders, whilst the textile revolution stimulated the production of iron for which coal was an integral part of the productive process. The adoption of coke in the smelting process and raw coal in Cort's reverberatory furnace meant a rapid increase in the demand for coal, apart from the rise in the use of coal in other industrial processes and for domestic consumption. A rapid increase in the demand for coal could be satisfied only by working deeper and more extensive collieries which in turn produced problems for colliery proprietors associated with drainage, ventilation, winding, haulage, transportation and management. Transport facilities proved the over-riding factor, for without improved modes of communication, inland coal could not be transported any considerable distance without incurring prohibitive costs. The capital expenditure needed for more extensive collieries and better transport facilities, was beyond the resources of many colliery proprietors, and so it fell to the landed interest to provide the necessary capital investment. The foundations of the coal industry were laid between 1750-1830, in which the landed interest was to play a major role, for it was through their capital investment that the coal industry was able to take advantage of the huge demand for coal, and in turn assist the rapid expansion of the nineteenth century economy.

CHAPTER THREE

THE NORFOLKS AND ROCKINGHAM-FITZWILLIAMS AS COLLIERY ENTREPRENEURS 1750-1830

The Norfolks as Colliery Entrepreneurs

The eighteenth century witnessed a more direct involvement by the landed interest in the exploitation of their minerals than in previous centuries. This was facilitated by the concentration of economic and political power within the landed aristocracy, which ensured the minimum of state intervention in the development of their coal reserves.(1) Such freedom of action enabled the landed interest to take advantage of the expanding coal market and in so doing, raise their mineral revenues. It is therefore not surprising that during the eighteenth century many members of the landed aristocracy such as the Norfolks and Rockingham-Fitzwilliams in South Yorkshire, Devonshires in Derbyshire, Dudleys in Staffordshire, Lowthers and Curwens in Cumberland, and the Brandling and Liddells in Northumberland and Durham, became substantial colliery entrepreneurs. For many landowners it was true that: 'To a large extent the interest of landlords in commercial and industrial activity was a logical extension of the development of their estates'.(2) This was understandable as most colliery materials were supplied directly from the estate, including wood for lining shafts and supporting the roof, stone and bricks to construct the engine houses, iron for pumping and winding engines, and fodder for the pit animals.

The coal reserves on the Sheffield estate of the Dukes of Norfolk, had for many centuries been worked either under lease or direct management.(3) This pattern continued into the eighteenth century. For example, on 29 September 1737, the 9th Duke of Norfolk granted a lease to John Bowden, a colliery entrepreneur of Beighton, to mine coal in the Sheffield

parish, the Park and the Attercliffe and Darnall commons, over a period of 21 years. Bowden was permitted to set up engines and manufacture coke, in return for an annual rent of £400 plus one-fifth of the value of all coal worked in excess of this sum. Twenty wain-loads of coal had also to be delivered free of charge to tenants of the Sheffield corn mills, the price and measure of coal could not be altered without prior consent, and he could not employ more than 15 master coal getters with their usual assistants.(4) On the expiry of the lease in 1758, the Wood Pits (Sheffield Park Colliery) and Manor collieries were again taken into direct management. Norfolk may have encountered difficulty in leasing the collieries due to the depressed state of the coal market on the outbreak of the Seven Years War, and the near exhausted condition of the pits which needed further investment to continue working. As many of the industrial consumers relied on the supply of coal to continue production, and as any interference with supplies would have put in jeopardy the ability to pay their rents to Norfolk, the collieries could not have been abandoned without adversely affecting the revenue of the Sheffield estate. In order to ensure future coal supplies, Norfolk purchased the Sheffield pits from Bowden for £194-16-9½, although at the same time he was aware of their potential profits, for in 1759 he was paying himself a rental of £1,000 per annum.(5)

An active period followed the acquisition of the Wood Pits and Manor collieries in 1758, with old pits being filled and new ones opened.(6) As a consequence, output at the Manor Colliery increased after the opening of a new pit, with production rising from 20,402 corves (797 tons) in the year ending October 1759 to 37,554 corves (1467 tons) in 1761. This reflected a more extensive scale of working. At the almost exhausted Wood Pits, severe competition from a colliery on Attercliffe Common, and adverse market conditions, led to a fall in output from 150,666 corves (5885 tons) in 1759 to 139,500 corves (5449 tons) in 1760. Competition became so serious that Norfolk, as lord of the manor, attemp-

ted to take out an injunction to prevent Attercliffe coal crossing the common. Coal sales did increase during the following year from 140,655 corves (5494 tons) to 156,000 corves (6094 tons), probably in response to the growing demand for coal and iron goods during the Seven Years War, for with the termination of hostilities in 1763, there again followed a decline in sales at both the Wood and Manor pits.(7)

The Duke of Norfolk can be seen as a reluctant colliery proprietor, taking the mines into direct management only when no acceptable lessee was available. This view is reinforced by the fact that in 1765, the collieries were again leased. Other factors may have affected the decision to lease the collieries. Norfolk was then 79 years old and he may not have felt inclined to shoulder the problems and risks of management. Fluctuating profits and rising production costs after 1762, could also have played a part in Norfolk relinquishing direct control. Expenditure in money terms rose from £1,494-9-10½ in 1762/3, to £1,614-17-4 in 1764/5, with the balances declining from £1,205-13-0 to £1,165-2-7, and following the sharp fall in coal sales after the Seven Years War, there was little opportunity of an improvement in the short term.(8) In spite of these factors Townsend and Furniss, the new lessees, believed that in the long run they could work the collieries at an increased level of profitability. The Sheffield Park and Manor collieries were leased in 1765 at a rental of £1,000 per annum, to provide Norfolk with an income similar to that when the collieries were under direct management, but without the associated risks. The lessees further increased their mining commitment in 1777 when they rented the Gleadless Colliery for £50 per annum.(9)

The Sheffield collieries worked by Townsend and Furniss were easily the most lucrative of the Norfolk mines, returning £1,000 out of a total coal rental of £1,135-13-0 in 1771/2.(10) In addition to their mineral rents, the proprietors were also landed tenants, leasing land and farms to provide

grazing and bedding for the pit animals, with Furniss for example, paying £232-11-6 for farm rents in 1776/7.(11)

Whether the landed interest leased or directly managed their collieries, it was necessary to employ viewers to assess the condition of the mines and recommend improvements, as gross mismanagement could lead to a serious loss of revenue in later years. A report on the Sheffield Park Colliery in 1773, for example, suggested reducing the number of pits worked, from five to four, and the installation of gins to draw larger 16 peck corves.(12) Of greater importance was the recommendation to construct a waggonway from the pit to the coal yard in Sheffield, to help to alleviate the severe competition from the colliery on Attercliffe Common, which enjoyed lower transport costs. The report claimed that a waggonway would reduce the cost per load (42.5 cwt) of coal from 2s 6d to 1s 0d and enable Norfolk to raise the colliery rental:

> 'The site of the Colliery in Question, naturally points out a Waggon Way to be laid to a Coal-Stage near the Town, there to deliver the Coals for the regular Supply of a great Part thereof, which being effected wou'd greatly tend to the Emolument of his Grace, and on which a great Part of the subsequent Calculation for letting it is grounded.'(13)

Although the estimated cost of laying the waggonway using oak and beech rails was £2,000, the actual sum expended rose to £3,280. To construct the waggonway and develop the collieries, the lessees borrowed £5,200, with the capital and interest taken into account in calculation of the rent.(14) The reduced transport costs afforded by the waggonway enabled Norfolk, in a new lease of the Sheffield Park and Manor collieries in 1774, to insist on a standing or fixed rent per annum of £1,000 and £50 respectively, and 44s per ten (44 loads or 38 tons) on all coal worked above 600 tens (19,800 tons) at the Sheffield Park Colliery, and 8s per cart load (17 cwts) above 4,400 cart loads (3,800 tons) at the Manor Colliery. The imposition of royalties resul-

ted in Townsend and Furniss paying £460 more than their old rent by 1779.[15] However, the revised colliery rental and loan repayments proved too burdensome for the lessees, and contributed towards their financial crisis and withdrawal from mining. This showed the difficulty in assessing a fair rent to satisfy both lessor and lessee, in relation to the risks involved in colliery management, as any miscalculation could threaten the whole enterprise:

> 'The Colliery at this period of time, was wrought at a moderate expense by reason of the Shallowness of the Pits, the great quantity of hard in consequence produced, and the short distance to the Town and notwithstanding the Rent being somewhat advanced to his Grace, left a little profit to the undertakers but not sufficient encouragement after sinking such a sum.'[16]

Profits were further affected as the workings moved away from the town and market, and deeper under the Park, where geological faults increased production costs and where the greater proportion of low value small coal reduced revenue. The proportion of hard to small coal in 1774 was three to five, which by 1779 had declined to one in three. Profits continued to fall, until by Christmas 1778, they were some £60 in deficit, with a forecast that in 1779 the debt would amount to £250. The Gleadless Colliery too had received little profit after an investment of £630, and by 1781, the lessees were losing on average £100 per annum, and if it was to continue working, a colliery report suggested, the rent should be held back for three years.[17]

The lessees surrendered their lease on Lady Day 1781 following severe financial difficulties, and the collieries once more came under the direct management of the estate.[18] New lessees would not have been attracted to collieries that needed considerable capital investment to overcome their unprofitability, caused by geological problems, competition and a slump in

coal sales. On the other hand, to abandon the collieries would have meant a serious loss of existing capital and revenue, and would have produced irreparable damage to the Sheffield manufacturers. The Norfolk estate appears to have been the only organisation with sufficient capital to take over such a high risk enterprise.(19)

The Sheffield collieries were taken into direct management by the estate's trustees, for on the death of the 9th Duke of Norfolk in 1777, the titles under a settlement of 1767 went to Charles Howard of Greystoke, whilst the profits from the Sheffield estate reverted to the 10th Duke's son, who took the title Earl of Surrey. The estate and its collieries were placed under the management of trustees until 1786, when the 11th Duke inherited the property.(20) Far from being conservative in their management of the estate, the trustees were prepared to embark on a major investment programme in the exploitation of the Norfolk coal reserves. However, the advice and support of the Duke of Norfolk and Earl of Surrey would have been sought before any decision concerning the collieries was taken. Neither were the trustees without managerial expertise, as the Earls Strafford and Scarbrough were substantial coal owners in their own right, and since the 1770's the services of John Curr, a highly proficient colliery engineer from Durham could be called upon. The decision to bring the collieries under direct management marked a crucial point in their development as the problems associated with faulting, depth of working, competition, drainage and scale of production called for large-scale capital investment. On taking the collieries 'in hand' the necessary investment was forthcoming, along with a determined attempt to place the enterprise on a sound financial base. A colliery report compiled by Curr in 1784, referred to £4,700 having been spent on the Wood Pits.(21) However, the Wood Pits found difficulty in overcoming the shortage of leaders to carry their coal into Sheffield. In comparison the Attercliffe and Manor collieries were able to employ three

times as many leaders as the Wood Pits, where the leading of hard coal some 800 yards was often only 6d cheaper than carrying coal from Attercliffe, a distance of three miles. There were further problems associated with working coal at twice the depth in 1784, than a decade earlier, whilst the output of small coal still remained excessive. Even as late as 1787 John Buddle, senior, reported that the Sheffield Park Colliery (formerly known as the Wood Pits) workings were interrupted from the deep to the bassett levels by a large 'Dyke or Mare' that threw the coal up some 11 or 12 yards.(22) As a result of these technical and transport difficulties, the costs of production increased and adversely affected the colliery's profitability. However, the effect of these difficulties would have been even more severe without the introduction of Curr's innovations, such as underground roadways and conductors, which contributed towards raising profits. However, these technological improvements produced an adverse effect on the Attercliffe Colliery, also owned by Norfolk, by becoming a serious competitor with it after 1789 in small coal. The smaller Manor Colliery underwent a period of capital investment, with the sinking of new pits and the introduction of technical improvements. Pit sinking continued into February 1785 when three pits were sunk - a deep pit, a bassett pit and another that was recorded in a weekly account costing £177-14-0. In 1784 Curr was introducing underground waggonways with expenses recorded for road levelling and sleepers.(23) The 11th Duke of Norfolk inherited the titles and complete control over the estate on the death of his father in 1786, and continued the direct management of the collieries. However, Norfolk was not prepared to shoulder the cost and risk of the enterprise alone, and on sinking the Attercliffe Colliery took a partner in Vincent Eyre, land agent to the Sheffield estate.(24) The sharp rise in demand for coal from the Sheffield manufacturers in 1786 prompted Norfolk and Vincent Eyre to embark on a major investment programme, with the sinking of the Attercliffe Colliery. A copy

of a bill in Chancery relating to a legal case between the Duke of Norfolk and Staniforth, states:

'...that in the s.^{d} year 1786 the Town of Sheff.^{d} in the West Rid.g of the s.^{d} Coy of YK was very scantily supplied with Coal & sustained very great an Inconvenience by the want of an ample Supply thereof w.^{ch} induced your Onor the s.^{d} Duke and yerd Vinct. Eyre in Coptnershp to qr. to make an attempt to win a part of the afores.^{d} Bed of Coal in order to accommodate the s.^{d} Town of Sheff.^{d}....'(25)

The Attercliffe Colliery was a major undertaking planned on a large scale to work 90 acres of coal at a depth of 100 yards. Sinking commenced in December 1786 and was completed after two years, although full production was not achieved until 1789. In comparison to many earlier eighteenth century pits, whose working life was usually between two to three years, the Attercliffe Colliery was expected to last for several decades. At Attercliffe the haulage of large quantities of coal from depths of 100 yards, made it cheaper to construct permanent shafts lined with bricks and timber, joined by roadways that could be extended as the workings progressed outwards, than to sink new shafts every two to three years. The total expenditure involved in opening the Attercliffe Colliery from December 1786 to June 1790, amounted to £13,822-16-11, representing, up to that time, the largest single investment in the exploitation of coal under the Sheffield estate.

Involvement by land agents in their employers' enterprises, was not unusual in the latter half of the eighteenth century, for in addition to being large tenant farmers they were a source of capital. Vincent Eyre made a considerable investment in the Sheffield collieries as shown by an agreement with the Duke of Norfolk on 5th March 1789:

'...in consideration of the great Costs and Charges amounting to many Thousand pounds which have been already incurred and still remain to be incurred in the Opening Winning and Working the Seams

> or Beds of Coal....Hereby demised....in Consideration of the yearly Rent...made payable to...the said, Duke of Norfolk Hath granted.... unto the said Vincent Eyre...that Mine Seam or Bed of Coal lately opened and now commonly called the Attercliffe or Darnall Coal.'(26)

The agreement granted Eyre the right to mine coal for 21 years in Handsworth and Sheffield, and to be paid one quarter of the clear profits per annum after the deduction of any capital expended. However, later evidence states that the cost of working the collieries and their profits were to be shared equally between the partners, with Eyre receiving 10 per cent per annum on the 'Capital' or 'gross sum' of any money he invested.(27) A moiety on the property was given to Eyre as security on the capital invested:

> 'The several Collieries of the Duke of Norfolk being carried on at the joint & equal expense of his Grace, & his Agent Vin. Eyre, & in Partnership betwixt them the Duke as Ground Landlord or Owner of the Coal, receiving from (the Partnership Fund a Rent for such coal)'(28)

This arrangement had the additional benefit that Norfolk could leave the overall management of the collieries to his land agent, who, having a financial stake in the enterprise, had more incentive to see they were properly conducted. In spite of the partnership with Eyre, the Duke of Norfolk was still not following the increasingly common practice by the end of the eighteenth century, of reverting to the position of colliery lessor.(29) Indeed the Norfolks were to invest further large sums in opening new pits, purchasing collieries and high cost capital equipment.

The Norfolk and Eyre partnership was not a highly remunerative venture, due mainly to the adverse working and market conditions encountered in the late 1790's. At the Attercliffe Colliery coal sales suffered a sharp decline from 20,766 tons of hard coal and 62,483 corves (18,745 tons) of small coal in 1793/4 to 12,301 tons hard coal and 54,247 corves (16,274 tons) of small coal in 1794/5. This situation was aggravated by competition from the Duke's own Sheffield Park Colliery, which ironically, was raising its production and

profitability following the introduction of Curr's innovations. The financial crisis arose from an unexpected flow of water into the workings from a nearby colliery, which necessitated the installation of three additional pumping engines, whilst geological faults raised production costs and impeded output. These difficulties seriously affected the colliery's profitability by raising the cost of production from 2s 10d per ton in 1793/4 to 3s 7½d per ton in 1794/5.(30) There was also the need for additional expenditure to maintain and expand output during a period of rising capital costs. A new pit was sunk in 1792/3 'near the Chapple' costing £400 which included sinking, putting in conductors, waggonways, head gear and a winding engine. In comparison, the cost of a pit sunk to a depth of 300 feet in 1773 at the Sheffield Park Colliery, amounted to only £160. A further 'winning' was made near 'Dakin's Colliery' at a cost of £1,334-13-0 with £370-0-0 for a steam winding engine.(31) Yet by far the most expensive items of expenditure at Attercliffe were on the installation of pumping engines to prevent the colliery being overwhelmed by water from Staniforth's mine. Eventually some four pumping engines were purchased, costing at least £3,902-0-0.(32)

> '...it was deemed necessary for the very existence of the Attercliffe Colly. to erect a fourth Engine, towards the South end of the Colliery, and which was accordingly done about four years Ago', so that now the Attercliffe Colliery had four large Engines to Support, at the enormous expense of from Five to Six, Thousand Pounds a year.'(33)

Although initially the Norfolks may have been reluctant colliery proprietors, on taking over their management, they were prepared to invest considerable capital sums. Not only did they refuse to divest control when lessees could easily have been found in the late 1780's, but continued to acquire and sink new collieries. In March 1790, the Duke of Norfolk took 'in hand' the Hesley Colliery in Chapeltown, which supplied the local Chapel Furnace and nail forges. Immediately on taking over its management,

Curr was recording expenditure on new pits, a steam drawing engine, head gear, conductors, and waggon ways. Although the Hesley Colliery remained a relatively small undertaking, the capital equipment introduced by Curr, allowed the colliery stock, along with the Duke's 'interest', to be sold to Richard Swallow for £2,500 in 1804.(34)

After completion of the Attercliffe Colliery in 1786, there followed within the next 18 years the sinking of two further mines at the Ponds and Crooks Croft. A 'winning' was made at the Ponds in 1789, and although it is not possible to calculate its cost, John Buddle produced an estimate of £4,500 for a colliery on the site in 1787. By 1800 the Sheffield Park Colliery was the deepest in the area, with its workings extending northwards under the town, and under Sheffield Park to the south. As the extraction of coal at depths of 100 yards or more raised production costs and made the sinking of new pits expensive, it was thought expedient to make a 'winning' at Crooks Croft some 48 yards from the surface, rather than to extend the Sheffield Park Colliery.(35) The Crooks Croft Colliery was sunk between 1801-4 at a considerable cost to become the major producer of coal in Sheffield. According to John Buddle, who had submitted a report for a colliery there in 1787, it would work 315 acres, at 7 acres per annum, with a life expectancy of 45 years. Again no evidence has survived relating to the cost of opening the colliery, but Buddle's estimate had been for a mine costing £8,190. Some indication of the expenditure involved can be seen in the 1805 valuation of the collieries, which recorded a 50 inch cylinder pumping engine, which in 1798 would have cost approximately £2,004. Adjacent to the main pumping engine was a machine for drawing coal valued at £294-1-5, and underground 2,871 yards of cast iron rail road worth £514-4-0 to produce a total stock valuation of £3,224-0-2 out of £12,656-5-9 for all the collieries.(36)

Apart from the expenditure required for opening new collieries and extending existing works, capital was needed to buy out local competitors, with the intention of reinforcing the Norfolk coal monopoly. Competition from the Darnall and Dore House Collieries had prevented Norfolk from raising coal prices to cover the rapid rise in production costs during the last decade of the eighteenth century. When the opportunity arose, Norfolk and Eyre purchased the Darnall Colliery from Clay & Co. for £8,000 in 1798 and the Dore House Colliery for £5,313-10-0 in 1801.(37)

The last quarter of the eighteenth century marked a crucial period in the development of the coal and iron industries. The Newcomen and Watt steam engines not only enabled collieries to be worked at greater depths, but increased the rate at which coal could be raised to the surface. Henry Cort's puddling process reduced the cost of malleable iron and after 1750, the widespread adoption of coke in the smelting process lowered the cost of cast iron. The lower price of iron enabled rails, conductors, pumping and winding engines to be adopted on a more extensive scale, and in turn such purchases assisted in alleviating the effects of the rapid decline in munition orders after 1815, and contributed to the long-term stability of the iron industry. The inter-dependence of the coal and iron industries can be seen in the development of the Sheffield mines, for not only were the local ironworks major coal consumers, but they in turn supplied iron goods to the collieries. Prior to 1765, the major items of colliery expenditure included pit sinking, headings, punches and driving soughs, but after 1781 iron became the largest single item of expenditure. Out of a total expenditure of £13,822-16-11 in opening the Attercliffe Colliery, £3,450-15-1½ was for iron goods. The collieries placed regular orders for iron goods for capital and current working projects, such as £228-11-8 on iron at the Attercliffe Colliery and a steam winding engine costing £370-0-0 for 'Dakin's Colliery' in 1789/90, and by 1799 at Attercliffe there were four pumping engines

working at an estimated purchase price of £3,902-0-0. The major contracts for iron were placed with ironmasters on the Norfolk estate, especially Booth & Co. of the Park ironworks until John Curr established a foundry in 1792 to become the major supplier to the collieries. Between March 1792 - March 1801, Curr supplied castings to the Sheffield and Manor collieries to the value of £5,643-1-0½, malleable iron worth £159-6-1½, and an engine for drawing coal at £200-0-0. Over the same period, he supplied the Attercliffe Colliery with £7,711-12-10 of castings and a cylinder to draw coals at £355-0-0, bringing the total value of iron goods produced by Curr for the Sheffield collieries to £14,069-0-0.(37a)

During the last quarter of the eighteenth century, the Sheffield collieries experienced the national trend of rapidly rising capital and current costs. The situation was exacerbated by the fact that as the collieries became deeper and more extensive, a greater quantity of capital equipment was needed in the form of waggon ways, conductors, steam winding and pumping engines.(38) Unfortunately, the Sheffield colliery accounts do not consistently differentiate between capital and current expenditure and therefore it is not possible to calculate with any considerable degree of accuracy the level of capital investment, but it is nevertheless possible to calculate the expenditure involved in opening some of the collieries and shafts. At the Attercliffe Colliery, between 1786-96, there was an investment of at least £16,244-10-11, and by 1784 some £4,700 had been expended on the Wood Pits, and according to Curr, there was an investment of £20,000 in the Sheffield collieries by 1793. This brings the estimated total expenditure on opening new collieries, introducing machinery and acquiring neighbouring mines to £47,198-0-11 between 1781-1805 although in real terms these figures are tempered by the general inflationary trends during the French and Napoleonic Wars. The capital stock at the collieries also showed a marked increase between 1758-1805, reflecting their economic development.

In 1758, the whole stock of Sheffield Park and Manor collieries was purchased for £194-16-9½ from John Bowden. This had increased to £6,274-19-1 in 1805 at the Ponds, Crooks Croft and Manor Pits that Norfolk worked in the same area as that previously under lease to Bowden. By adding the Handsworth Colliery, valued at £6,361-6-8 along with the property, fodder and livestock, the total valuation for the Norfolk mines amounted to £16,515-7-3½.(39)

In addition to increased capital costs, general inflationary trends, fluctuations in demand and adverse working conditions seriously affected the profitability of the Sheffield collieries. It was the whole range of production costs that saw the effects of inflation, from wage and material costs to animal feedstuffs. Nationally, costs experienced a considerable rise between 1780-90, but these were eclipsed by the spectacular rise from 1790-1800 as a consequence of the French Revolutionary and Napoleonic Wars, that more than outweighed the increase in output and coal prices.(40) In 1801 John Curr commented on the poor condition of collieries in the country, the lack of profits at a local colliery owned by Staniforth, and the Duke's concerns that were suffering from:

> 'The high prices of hay and Corn, Workmens wages in acct. of the high price of Provisions, Punch Wood and leading, Deal Timber, Powder, Ropes, Candles, Iron, Cast Iron, & Oyl & have for 2 years past been distressing ...'(41)

The situation in Sheffield was exacerbated by the fact that acute local competition prevented an increase in prices to cushion the effect of rising costs, whilst internal cost factors, such as major geological faults, deeper workings, drainage problems and greater distances from market, assisted in reducing profits. For example, an adjacent colliery belonging to Staniforth was accused of breaching the barriers. This caused a vast amount of water to flow into the Darnall and Attercliffe Collieries and Curr wrote that his inventions had been buried;

'...in an unfortunate undertaking, which has been deluged with water, having not only the dukes but 2 other collieries water to draw ...'(42)

The 11th Duke and the executors of Vincent Eyre took Staniforth to the York Assizes in 1803, claiming that four large pumping engines had to be installed at Attercliffe, but still sufficient water was entering the workings to prevent all the coal being extracted, and as a consequence they demanded damages of £10,000. The prosecution was to prove expensive for the plaintiffs, for not only did Norfolk lose the case, but costs of £665 had to be paid plus a further £30 in an attempt to reverse the decision.(43) The high cost of drainage proved the major factor in creating the serious financial crisis at the Attercliffe Colliery. In 1800, for example, Curr calculated the cost of running the pumping engines at £3,000 per annum, which compares with the total sales for the year of only £9,335-0-0. The inflow of water into the workings also brought about a vast increase in fuel consumed by the engines and fire pan, with consumption rising from 5,585 tons in 1789/90 to 8,435 tons by 1799/1800.(44)

The huge capital investment in the Norfolk collieries between 1781-1805 did not reduce unit costs due to the rise in material costs and wage rates. In 1761/2 total expenditure at the Sheffield Park and Manor Collieries amounted to only 54 per cent of total revenue, but by 1799/1800 this had risen to 77 per cent. The latter figures include the vast increase in capital expenditure, cost and price inflation, and the consequences of mining coal from greater depths on a more extensive scale. It was such high costs of production and uncertain profits that persuaded many landed proprietors to lease their collieries to a consortium of businessmen better able to raise the necessary capital and bear the risks of management.

The estimated average wage cost in producing 19,800 tons of coal at the Wood Pits (Sheffield Park Colliery) in 1773 was 1s 4½d per ton, but

by 1790/1 this had risen to 1s 10¾d per ton on 22,023 tons, and by 1797/8 to 3s 2d per ton on 16,426 tons, with wage rates rising more rapidly than output. Wage costs also rose at the Attercliffe Colliery, where average costs of production increased from 1s 10d per ton in 1789/90 to 5s 11¾d per ton in 1798/99, and whilst average costs rose by over 300 per cent in nine years, output fell by 1,262 tons from 34,593 tons to 33,331 tons. However, the adverse effect of inflation and production difficulties may have been more severe without the high level of investment and the introduction of Curr's innovations. There was probably some credence in Curr's statement that: '... bad as the Collieries have lately proved, they would have been much worse if I had not made the improvements I have stated ...'.(45)

To what extent was the period of high capital investment in the Norfolk collieries between 1781-1805 reflected in output and profits? In 1737 the output of the Sheffield collieries under lease to John Bowden, was limited to what 15 'master getters' and their assistants could work.(46) This amounted to approximately 150,666 corves (5,885 tons) at the Wood Pits and 20,402 corves (797 tons) per annum at the Manor Colliery in the 1750's. During the period when the collieries were taken 'in hand' between 1758-1765, average production at the Wood Pits and Manor Colliery was still only 149,646 corves (5,846 tons) and 31,617 corves (1,235 tons) respectively. However, by 1773, when the collieries were again under lease, it was estimated that the Wood Pits were capable of producing 600 tens (19,800 tons) an increase of 339 per cent and an output that was barely improved upon prior to 1801.(47) Even the major capital investment programme undertaken in the Norfolk mines between 1781-1801, was not reflected in any dramatic increase in coal production at the Sheffield Park and Manor Collieries, with the average output at the Sheffield Park Colliery remaining at 18,227 tons per annum.(48) Investment in the existing collieries was not

carried out to increase the scale of production, but to overcome geological difficulties and facilitate the movement of coal to enable the continued working of the mines. The overall increase in output was achieved only by opening new collieries at Attercliffe, Ponds and Crooks Croft. In 1773, the estimated output of the Wood Pits of 19,800 tons per annum had only risen to 23,351 tons by 1800/01, compared with the production of the Attercliffe Colliery alone of 44,538 tons, whilst the combined output from the Ponds, Attercliffe, Darnall and Hesley collieries in 1802 was approximately 99,840 tons.(49) The Norfolk collieries experienced an increase in output of 504 per cent, from 19,800 tons in 1773, to 99,840 tons in 1800/01, which compares with Ashton and Sykes national increase in output between 1770-1800 from 6-10 million tons or 66.7 per cent.(50)

In calculating the profitability of the Sheffield collieries, certain difficulties soon become apparent, not least being the lack of substantial documentary evidence from the earlier period under study. Profits were distorted by the practice of not differentiating consistently between capital and current expenditure, although prior to 1781 this was not a major disadvantage, as capital investment was limited. For the first six years from 1758 when the collieries were under direct management, there was a steady increase in profits in money terms. In 1758/9 the balance amounted to only £935-15-4 but by 1759/60 this had increased to £1,112-11-7, and in 1763/4 to £1,205-13-0. Over the seven years the collieries were 'in hand', the total balances amounted to £8,067-4-0 compared to approximately £5,948 if Norfolk had leased out the pits. Although the Sheffield estate received a higher income from the collieries under direct management than when they were leased, if the Duke had demanded a rent of £1,000 per annum from a lessee, (as he charged himself from the balance), this would have left very little, if any, profits for the lessee.(51)

In spite of a fall in demand and profits and a rise in production costs at the Sheffield Park and Manor collieries by 1764/5, the lessees were prepared to lease the collieries at £1,000 per annum. They thought the profitability of the collieries could be improved, even though the balance in 1764/5 was only £1,165-2-7, which after allowing for a rent of £1,000, would have left only £165-2-7, hardly sufficient for the risk and capital involved. However, any optimism must have soon dissipated, for between 1765-1781, the highest profits received from the Sheffield Park and Manor collieries, including a large farm (Paddocks), amounted to only £777.(52)

The profitability of the Sheffield collieries soon showed a marked improvement once they were taken into direct management in 1781 as a result of considerable capital investment, the introduction of technical innovations and opening of further collieries. After allowing for rent at the Wood Pits and Manor Colliery of £1,000 and £75 respectively, in 1788 they showed a return of £1,374-16-4 on 'profits and interest on monies expended' compared to £580-5-9½ in 1783/4. The Attercliffe and Ponds collieries paid 'tolerably well', and in 1793 they returned £4,600 after the deduction of rent and punchwood.(53) After reaching their peak in 1793 the profitability of the collieries steadily declined following a fall in demand, rising wage and commodity prices, and the high cost of drainage, which saw the mines in increasing financial difficulties. At the Attercliffe Colliery, for example, the 'profits and interest on monies expended' that had amounted to £1,605-2-8 out of a colliery balance of £2,365-12-1 in 1791/2, fell to £472-12-8½ in 1794/5 and to £317-15-8½ in 1796/7. The colliery appears to have been working at a loss between 1794/7, if wood and rent are deducted from the balances and it was not until 1800/01, following a rise in coal prices and sales, that a small profit was made, with a balance of £1,182-14-7.(54)

The Sheffield Park and Manor collieries also experienced a sharp fall in profits with total money balances declining from £2,380-4-6½ in 1796/7 to £1,690-11-4 in 1798/9 and £200-12-9½ in 1800/01, when they were being worked at a loss. These figures are in sharp contrast to the total balance for the two collieries of £4,043-7-8 in 1791/2. It was the continued unprofitability of the collieries that persuaded the Duke of Norfolk to dismiss John Curr on 14 October 1801:

> '... the want of success in concerns so important to myself & the trade of Sheffield, has appeared to me a sufficient reason for placing the management of them in other hands, to try whether different measures may not produce better consequences.'(55)

However, Curr's dismissal came at a time when the collieries' profits were already improving and this appears to have continued after 1801, with the total money balances of the Attercliffe, Sheffield Park and Manor collieries rising from £5,266-13-10 in 1799-1801 to £10,537-3-0½ in 1802-4, whilst from March 1802 - March 1805 they amounted to £24,167-3-10¾. A more accurate guide to the profitability of the collieries may be seen from the combined withdrawals made by Norfolk and Vincent Eyre's executors, of £21,000 between 1804-5.(56) The seeming upturn in profits was achieved by strict economies such as reducing the number of pumping engines at the Attercliffe Colliery from four to two, and by raising coal prices. The proprietors were able to raise the price of coal following the purchase of the Dore House and Darnall collieries, as competition, especially from the former colliery, had previously prevented this course of action to cover the rapidly rising costs of production.

Until 1820, total mineral revenues remained a small percentage of total estate revenue even during the period of high profits from the collieries between 1788-1793. In 1767/8 the total income received from the Norfolk coal resources was £1,000 or 5.48 per cent of the total estate revenue, which

increased by 1787/88 to £2,861-4-4 or 8.55 per cent, and by 1791/2 to £6,014-14-8½ or 18.65 per cent of total revenue. During the years of high colliery profits, these more than kept pace with the increase in agricultural rents, but after 1793 they were to see a sharp decline. In 1803 for example when all the collieries were under lease, the fixed rent amounted to only £1,286-6-0 or 2.50 per cent of total revenue on the Sheffield estate. This situation was not reversed until after 1820, following increased rents from the Sheffield collieries and a decline in other estate rents, which resulted in the annual fixed rent rising by 1824 to approximately £5,050-0-0 or 17.76 per cent of the total estate revenue.(57) The Norfolks did not receive any long term revenues commensurate with the level of capital investment made in the collieries until after 1820, when they were able to perform an increasing role in the Sheffield estate following the decline in agricultural rents.

The lack of documentary evidence prevents any clear conclusion being drawn on whether the Norfolks were knowledgeable about mine engineering or to what extent they were involved in the direct management of the collieries. One of the most active periods of capital investment in the collieries occurred under the trustees, although the Earl of Surrey was almost certainly consulted in the decision making process. This can be seen in 1781, when a report on the Gleadless Colliery thought the Earl would not support holding the rent back for three years.(58) However, the day to day management of the collieries was undertaken by John Curr, as superintendent, but with checks on expenditure through the employment of mining consultants, who submitted reports on the opening of new collieries and the cost effectiveness of his innovations. When complete control over the collieries was attained by the 11th Duke in 1786, any major capital expenditure would have needed his sanction, and he was certainly prepared to take drastic action

to safeguard the profitability of the collieries, as shown in 1801, with the dismissal of Curr. On the other hand, if the collieries had been owned by a proprietor in closer touch with their management, Curr's dismissal may well have occurred sooner. There does appear to be some doubt on the ability of the Norfolks to respond quickly to changing managerial and market situations as shown by their late attempt to remedy the deteriorating financial position of the collieries after 1796. However, any detailed control over the collieries would not have been easy, due to the other estate activities of the Norfolks and Mee's description of the Earls Fitzwilliam could be applied equally to the Norfolk family:

> '... the Earls Fitzwilliam inevitably had to leave matters of day to day administration in the hands of their local managers ... therefore, for much of the time they were attempting to control the collieries and other enterprises from a distance and consequently had to rely mainly on the correspondence, and the regular submission of accounts and reports from the managers, to maintain contact...'(59)

As the landed proprietors managed their collieries as an integral part of their estates, there often occurred a transference of agrarian customs and paternal attitudes to their industrial enterprises. Underground workers were usually paid at fixed rates per waggon, yard or day, with their wages often supplemented as a result of any departure from the general work routine. In the Norfolk collieries free coal was provided to the pit 'sinker', in addition to regular supplies of flannel, powder and 'eating'. Ale was given regularly to the colliers, especially at Christmas, or when the employees went to the fair, whilst beef was provided on 'Codders Monday', and at agents' feasts. Ale or a money bonus was given for wet work, whilst picks, wedges, hammers, shovels and candles were provided free by the management. Although no regular payments have been found for injured colliers or widows, the accounts do occasionally record allowances to injured employees and doctors' expenses. This paternal attitude towards the workers,

was not shown by many of the new generation of capitalist entrepreneurs, who did not enjoy the same close relationships that were present in agrarian communities. This was illustrated locally in 1816, when colliers in the Sheffield pits, under lease to Sorby & Co., had to pay for their own working utensils.

The Dukes of Norfolk as Colliery Lessors

The early nineteenth century witnessed many landed colliery proprietors divesting their mining interests as the increased capital expenditure and growing technical complexities of colliery management encouraged many to revert to the relatively secure position of lessor. After 24 years of direct management the 11th Duke of Norfolk sold his 'interest' in the Sheffield collieries and leased his minerals. During the last two decades of the eighteenth century, the cost of sinking deeper and more extensive collieries had rapidly increased, while pumping and steam winding engines, surface and underground railways, represented major items of capital investment in an enterprise that proved at best risky and at worst financially disastrous. These risks were indeed real, for the collieries had been hindered by geological faults, fluctuating sales, severe competition, cost inflation, drainage problems and as a consequence from 1794, rapidly falling profits. It would appear that these factors determined Norfolk in 1805 to relinquish the direct management of the collieries, when profits had increased sufficiently to attract lessees. In addition, without the services of Vincent Eyre and John Curr, Norfolk may not have felt confident to carry on with the management especially as Thomas and Catherine Eyre were almost certainly not experienced colliery engineers or managers. The 11th Duke of Norfolk fell into that class of landowner described by Mingay:

> 'As the industrial revolution gathered momentum there appeared more men from outside the landed classes with sufficient capital to undertake the risks of enterprise, and the landlords, for the most

part, fell into the background as lessors and investors.'[60]

The Hesley Colliery, near Chapeltown, was the first to be leased with negotiations in progress as early as 3 October 1803. These were followed by the sale of Norfolk's interest in the mine on June 25 1804, to Richard Swallow, ironmaster and proprietor of the nearby Chapel Furnace, for £2,500. This included the 'working and open colliery materials', with a lease for 21 years of three beds of coal and ironstone.[61]

The sale of the Duke of Norfolk's other Sheffield collieries followed soon after the disposal of the Hesley Colliery. Although the lease of the Sheffield collieries granted to Vincent Eyre was not due for renewal until 1810, a new one was granted on 2 May 1805, to Catherine and Thomas Eyre. They acquired the right to mine coal in Attercliffe, Darnall and Sheffield Park in the Sheffield and Handsworth parishes, with use of the colliery equipment. The lease was for 15 years, from 25 March 1805, at a fixed rent of £750 per annum for 18 acres, with any excess to be paid at £75 per acre. Almost immediately on conclusion of the lease, the collieries were sub-let on 10 June 1805, to Charles Nixon of Walbottle, Northumberland, coal viewer, William Littlewood of Sheffield Park, ironmaster, John Sorby of Sheffield, merchant, and John Jeffcock of Sheffield, collier. Norfolk would have received prior warning of this arrangement, as the former lease did not contain any clause against sub-letting the collieries, which was usual in Norfolk leases, and two of the lessees, Charles Nixon and John Jeffcock had been respectively viewer and agent to the collieries.[62] Thus from 1805 the Norfolk collieries came under the direct control of a consortium of Sheffield businessmen and colliery agents, who were better able or more prepared to raise capital and bear the risks of management than the previous entrepreneurs. In addition to paying the annual rent of £750, the lessees were to purchase the stock and interest in the collieries for a total sum of £72,500 in 29 equal instalments. The low colliery rental appears to have

been arranged to attract proprietors who were prepared to purchase the whole enterprise.(63)

Little detailed evidence has survived from the period 1805-18 to show how the collieries were managed. Evidence on their profitability is also far from abundant. In 1818, the executors of William Littlewood had eight shares in the company with an investment of £11,266-13-4, John Sorby held four shares at £702-5-4, John Jeffcock held five shares at £7,041-13-4, and Edwin Sorby with one share represented an investment of £400-0-0. The day to day management of the collieries was the responsibility of John and Edwin Sorby, for which they were each paid an annual salary of £188-0-0. Any profits were divided among the partners in proportion to their shares, and deposited in their company current accounts. Even after payment of the rent and the £5,000 per annum instalment for purchase of the collieries, profits increased in comparison to the last years of Norfolk management down to 1818/1819. But profits were to experience a rapid decline between June 1819 and August 1825, reflecting both the national depression in the coal and iron industries and competition from neighbouring collieries. Between June 1819 and May 1821 the profits distributed among the four partners amounted to only £1,339-18-10 in comparison with £5,669-2-3 in 1819.(64)

The increase in profits at the Sheffield collieries between 1801-19 was paralleled by a rise in coal production, for most of this period especially after 1805. In 1800/1 the Sheffield Park Colliery produced 23,351 tons, the Manor Colliery 17,106 tons, and the Attercliffe Colliery 44,538 tons of coal. These figures compare with an output of 64,848 tons from 8 acres of coal at the Sheffield Colliery (Sheffield Park Colliery), 43,488 tons from 8 acres at the Handsworth Colliery (Attercliffe Colliery), and although there are no production figures available for the Woodthorpe Colliery (Manor Colliery), 3 acres of coal were extracted in 1817. There are no production figures available for 1818-1819. The Number 2 Deep Pit at the Sheffield Colliery alone produced about 425 tons of coal weekly in 1817, in comparison with the output from the Ponds (Sheffield Colliery) and Attercliffe collieries, the two largest, of 150 tons each per week in 1803.(65) The rise in output and profits was achieved without

using any more capital equipment than was present in the collieries in 1805. Instead they employed more relatively low cost labour, for whereas no more than 200 employees could be found in the Sheffield collieries in 1790, the Sheffield and Handsworth pits alone employed 281 workers by 1821. The value of the stock was drastically reduced, reflecting their policy of maximising output at minimum cost, which put in jeopardy the long-term profitability of the collieries. In 1820, the collieries were valued at £7,748-18-4½, compared with £12,656-5-9 in 1805 and whilst previously they had worked four pumping engines, five whimseys and five steam winding machines, by 1820 these had been reduced to one, two and four respectively. These factors may suggest that during the period of Curr's management, there was too much capital investment and insufficient emphasis on raising output and lowering unit costs. However, the increase in output and profits and the purchase of the colliery assets was achieved only by reducing the capital equipment, employing additional low cost labour, and exhausting the collieries at Handsworth and Woodthorpe. Whilst Curr may be criticised for insufficient managerial expertise, the lessees appear to have gone to the other extreme of running down the colliery stock and maximising profits to the detriment of Norfolk's long-term interests, for when the lease was renewed in 1820, a total of £18,000 was required to be spent on the collieries.

Although the Duke no longer bore the risks of direct management, his long-term mineral interests had to be protected. Viewers were employed to give advice on leases, calculate the quantity of coal extracted and report on the management of the collieries. A major difficulty associated with leasing collieries, was the conflicting interests of lessor and lessee, with the latter more concerned with short-term gains, rather than the long-term protection of the landowner's interests. The dangers involved in leasing are vividly illustrated in 1812, when the Norfolk lessees abandoned

the Crooks Croft Colliery, stopped the engine and removed the timber from the roof and pit shaft, allowing the River Sheaf to flood the workings. Materials were removed to another pit 1½ miles to the south, where the coal could be worked more easily without the aid of a pumping engine. In addition, the lack of any 'regular' working plans, put in jeopardy the efficient future exploitation of the coal. Although Norfolk sought legal advice in 1818, with a view to prosecuting the lessees over abandoning Crooks Croft Colliery, counsel pointed out that the lease did not prevent the lessees working the coal in a more 'advantageous' area. The Duke was advised to purchase the colliery materials, or failing this, to remove the machinery, as the proprietors could work the stock for a further 12 months after the expiration of the lease, to the great 'impediment' of the collieries.(66)

In extracting the maximum quantity of coal at the lowest cost, there was a danger that lessees would exploit the bassett coal and leave the more difficult, deeper coal. In this respect, William Stobart, viewer to the 12th Duke, was strongly critical of Sorby & Co. in 1817, who, on sinking a new colliery planned to leave the deep coal to the rise of a fault. Stobart requested they work the coal equally on the deep and so leave the colliery in a proper state. Likewise, Darwin & Co. proprietors of the Hesley Colliery, were reprimanded in 1825, for not locating their new engine pit nearer to the boundary with Earl Fitzwilliam's estate, which would have enabled them to recover all the coal. There was also a tendency for some colliery proprietors, especially towards the end of a lease, to neglect the water levels and put in jeopardy the recovery of all the coal. In 1820, for example, the nearly exhausted Handsworth Colliery, had a stoppage in its water course, that threatened working the remaining 18-20 acres of coal.(67)

Although the 11th Duke may have sold his interest in the collieries to rid himself of the problems of direct management, by 1820 the condition of

the mines presented even greater difficulties. The Crooks Croft Colliery, which had formerly been the town's largest coal producer, had been abandoned and its workings drowned; the Woodthorpe colliery was almost worked out and new 'winnings' were needed at the Sheffield, Manor and Handsworth collieries, whilst the flooded workings at Crooks Croft and a stoppage in the Handsworth water level, threatened the extraction of the remaining coal.(68)

Even though the Crooks Croft Colliery had been abandoned in 1812, it appears that independent viewers reports were only called for in 1817. This would tend to point once again to the lack of close control by Norfolk or the land agent over the collieries. Reports were submitted by William Stobart, James Losh and George Hill, on the condition of the collieries with recommendations for a new lease. William Stobart thought it advisable either to re-open Crooks Croft or make a 'new winning', and on the general condition of the collieries he commented:

> 'All these matters considered it must be confessd that the mines at present are by no means in so eligible a state as when enterd upon by the present Lessees in 1805, for at that period the Winning at Crooks Croft was complete, none wanted at either Handsworth or Woodthorpe, but every matter & thing in a regular & complete working state with the Buildings, Engines & Stock of every description of the Collierys amounting to upwards of 16,000 Pounds for which the Lessees had not to advance one penny, and not only this Stock, but the Lease of another Colliery called Dawer House Colliery was at the end of the present Term aperd to be given up to the present Lessees as their property.'(69)

A new lease on the Sheffield collieries, was granted on 13 November 1820, to Thomas Holy of Sheffield, Thomas Dunn of Sheffield, merchant, John Wilson of Sheffield, cutler, and William Jeffcock of Chester-le-Street, collier.

In light of Norfolk's experience with the previous lessees, the lease was made more specific, to guard against a repetition of the damage done to the collieries. The lessees were allowed to hold the collieries for 21 years from 25 March 1820, and pay an annual rent of £2,800 for 7 acres of the Sheffield Bed, £1,200 for 6 acres of the Sheffield Manor Bed and £500 for 5 acres of the Handsworth Bed, whether the coal was extracted or not. A further £100 was to be paid for every acre of any other seam worked. On taking over the lease, the lessees were to make a 'winning' of the Sheffield Manor Bed, in an approved position by 25 March 1822, or to have expended £8,000 in the attempt. If there were no more than 40 acres of coal left in the Sheffield Colliery, the lessees were also to sink a new mine in the Sheffield Bed to the deep of the present colliery towards the canal and Soap House, by March 1822, or alternatively to have invested £10,000. To prevent the collieries being left exhausted at the end of the lease, sufficient coal was to be left in the collieries for two years' working, except in the Handsworth Bed, and no building could be demolished or damaged without the permission of the Duke of Norfolk.(70)

After 1820, the lessees experienced serious physical difficulties in working the coal, and increasingly severe competition from local collieries which threatened their financial position. The proprietors were asked to sink a new colliery in an area where previously Booth & Co. had been unable to complete a winning, due to the inflow of water. Nevertheless, they acquiesced in the location of the colliery, but the amount of water encountered raised the expenditure on the colliery to £16,000 and delayed bringing the coal to market until January 1823, and then only in small quantities.(71) The proprietors' profits were also threatened by increasing competition from collieries lying to the south of Sheffield and adjacent to the Don Navigation and the Sheffield and Dearne and Dove Canals. So serious was the competition that on 21 March 1821, Holy & Co. petitioned Norfolk to use his influence to retain their exemption from paying the turnpike tolls in the

Park, and so retain their competitive advantage over rival collieries who had to pay the toll. By 1827 the proprietors were even more concerned about the competition and they once again complained to Norfolk that coal from collieries such as the Earl Fitzwilliam's Tinsley mine would prevent them ever regaining the capital, exceeding £11,000, sunk in the Handsworth Colliery.(72) The mounting difficulties experienced by the proprietors of the Sheffield collieries were reflected in fluctuating output and profits after 1820. According to John Sorby, the profits accrued to himself and the partners amounted to only £2,000 from 28 April 1821 - 16 October 1824. This was hardly sufficient compensation for the considerable capital invested, which by 1827 had exceeded £27,000 in the Handsworth and Manor collieries. The Norfolk coal monopoly was by this time being seriously threatened although it was not finally broken until the opening of the Sheffield to Rotherham Railway in 1838.

At this point we might summarise the foregoing discussion. Initially the Norfolk family were unwilling colliery proprietors, but nevertheless they developed the Sheffield mines into one of the major coal producing concerns in South Yorkshire. They took over the collieries in 1758 during a depression in the coal trade, when new lessees would have been difficult to find, and again in 1781, when Townsend and Furniss, who leased the Sheffield Park, Manor and Gleadless collieries from the Duke, felt incapable of continuing the lease following a decline in sales, major geological problems and a financial crisis. With Curr's engineering expertise and Norfolk capital they turned the Sheffield collieries from a small inland concern into a major undertaking employing some of the most advanced colliery practices. However, the rising costs and risks involved in large scale mining persuaded the 11th Duke of Norfolk in 1786 to seek a partner in Vincent Eyre, his land agent. Although the profitability of the collieries remained acceptable until 1794,

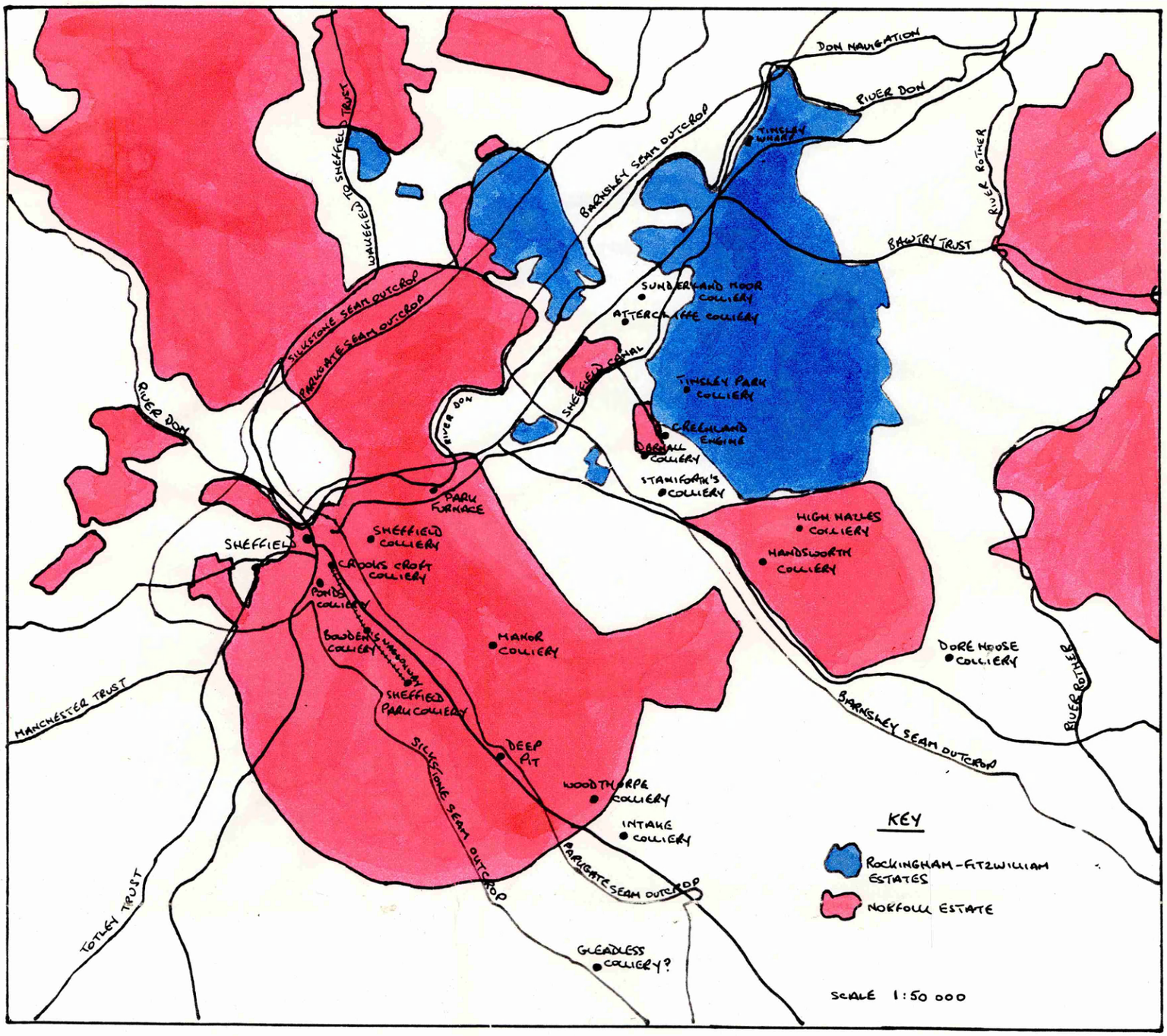
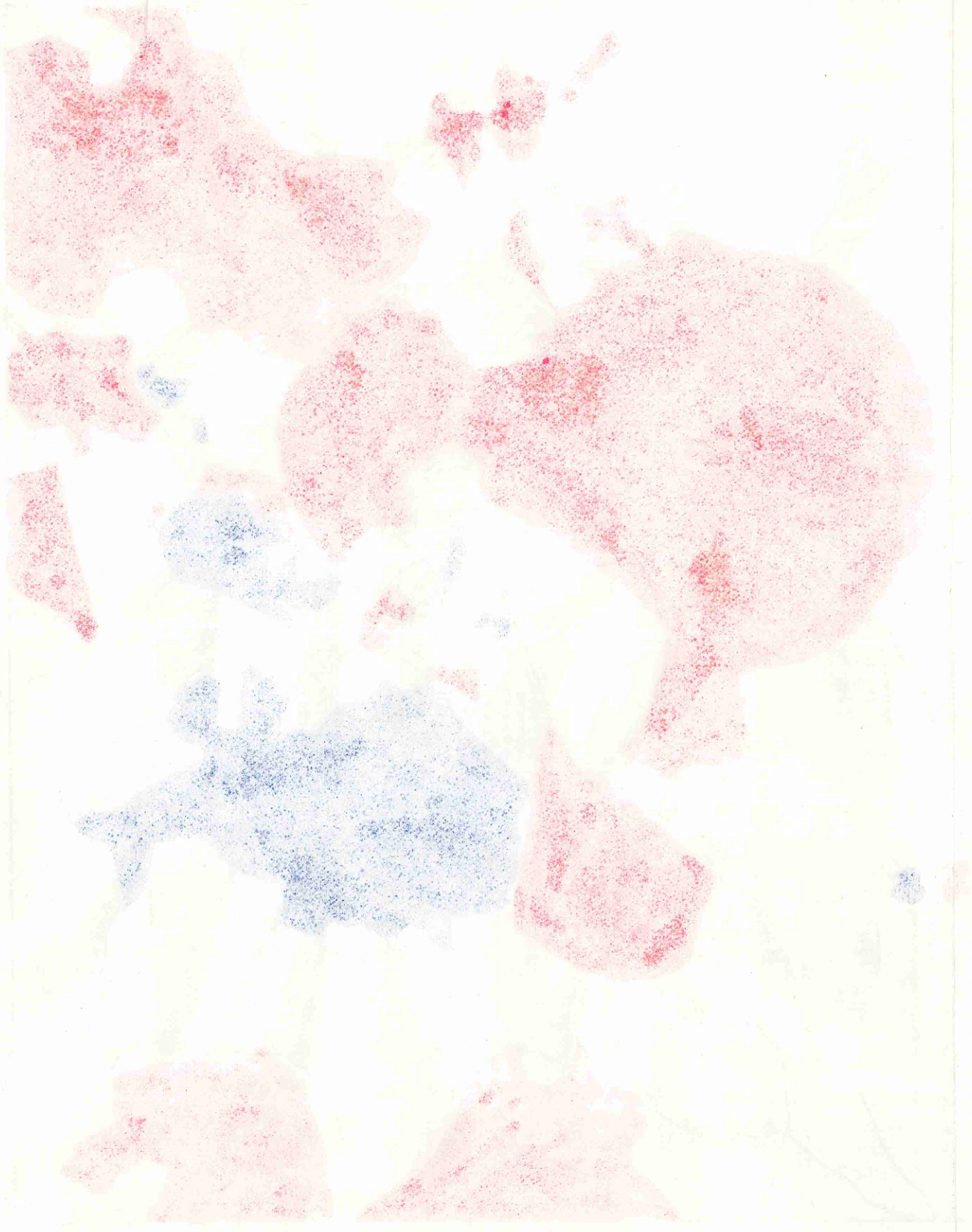


Fig IV.

THE SHEFFIELD COLLIERIES 1750 TO 1830



rising costs, competition, drainage and geological difficulties plunged the collieries into deficit by 1800. It was these factors that largely determined Norfolk to lease the collieries to a consortium of Sheffield businessmen, who were more capable of raising capital and bearing the risks of management. There followed a discernible change in the character of management, from the emphasis on capital expenditure and long-term planning, to the short-term profit maximisation policy of the lessees. The lessees, between 1805 and 1820 ran down the collieries capital equipment with the aim of reducing costs and maximising output, until by 1820, the mines were almost worked out, putting in danger future rents and profits. The rents were increased under a new lease in 1820, whose more rigid clauses required the proprietors to spend specific capital sums on the mines. Although the lessees experienced serious competition from rival collieries, Norfolk was able to receive regular and considerable income from his minerals at a time of declining agricultural revenue.

The Entrepreneurial Activities of the Rockingham-Fitzwilliams in the South Yorkshire Coalfield 1750-1830

Let us now turn to the second of our landed proprietors, the Rockingham-Fitzwilliam family, in the exploitation of their mineral resources.

On several occasions during the eighteenth century, the Marquis of Rockingham took over the direct management of his collieries when a suitable lessee was not available. This applied only to the small collieries located at Elsecar, Lowwood and Westwood, which could be managed with the minimum of capital and expertise. Rockingham continued to lease the larger collieries, such as the Carr House Colliery of John Bowden at Greasbrough, which employed 12 'getters' at £21 per man and the Basingthorpe Colliery of William and Thomas Fenton, who also took out a lease to mine Greasbrough coal in 1758 when Bowden surrendered his lease. The Basingthorpe Colliery was a more extensive undertaking employing 16 colliers at a rental of £40-10-0 per man.(73)

The Elsecar Colliery was owned by a Mr Monckton, until Rockingham purchased the mine along with the Skiers estate in 1750. Situated on the Brampton side of the Elsecar valley, the Lowwood Colliery worked the 9 feet Barnsley seam, under lease to Richard Bingley until 1763, at a rental of £17-0-0 per hewer. The Lowwood Colliery employing in the 1750's seven hewers in comparison with two at the Elsecar Colliery, of the two concerns the former colliery remained the larger undertaking until the 1790's. Of the Westwood Colliery little documentary evidence has survived. It was a very small concern employing two colliers at £20 each during the 1750's. Over the period under study it was leased to a number of lessees before coming under direct estate management between 1791 and 1801 and after Longdon and Co. of the Thorncliffe ironworks experienced serious working conditions with their colliery, they leased the Westwood Colliery in 1801. After this point the colliery passes out of the Household Accounts.

On acquiring the Elsecar Colliery, Rockingham opened negotiations with Richard Bingley to lease the mine. Bingley could only employ two hewers, at a rental of £35-10-0 per annum, but Rockingham allowed him to work the mine rent-free for two years, provided Bingley cleaned and repaired the levels, or failing this, paid a fine of £200. If the lease was taken up, it was soon surrendered, for on 1 September 1752, Thomas Smith was instructed to commence working the colliery. Acting as colliery manager, Smith was to employ two getters at 20d each for 39 pulls, one filler and one hurrier at 5d per pull, two men above ground at 5d per load of 39 pulls, a stacker at 7s per week, who in addition, was to keep account of all coal produced and sold. Thomas Smith was paid as a workman, with an extra £20 per annum as overseer of the colliery.(74) It is doubtful whether Rockingham seriously considered discontinuing the mine, for not only did it provide a small income, it also supplied Wentworth Woodhouse, and the industrial and domestic consumers on the estate. In the short-term, Rockingham was obliged to manage the colliery until suitable lessees were available. However,

direct management was not without its rewards. This was shown by a valuation of the Elsecar Colliery, which estimated the costs, revenue and profits of the remaining 11 years of Bingley's lease. It compared the rent of £392-14-0 that Bingley would have paid, with a clear profit of £2,067-6-0 that could be obtained under direct management. Even so, Rockingham was still prepared to lease the colliery, which he succeeded in doing, to John Hall, Thomas Smith and Jones in 1757/8.(75) In addition to the Elsecar Colliery, the consortium leased the Westwood and Kilnhurst collieries at a total annual rent of £340-0-0 for the remaining six years of Bingley's lease. Rockingham may well have felt that in Thomas Smith, the previous overseer of the Elsecar Colliery, he had found a suitable lessee to assist in their management.

It was probably the increased demand for coal during the Seven Years War, that encouraged Hall, Smith and Jones to manage the Collieries, for on the termination of hostilities and the ensuing slump in the coal trade, they reduced their mining commitments. The lessees relinquished the Elsecar and Westwood Collieries in 1763, but continued to lease property at Kilnhurst at £40 per annum until 1774/5.(76) The depression in the local coal trade was not only reflected in Hall & Co. giving up the Elsecar and Westwood collieries, but in John Bowden surrendering the Carr House Colliery on payment of £600, and the discontinuance of the Orgreave Colliery rental. When the executors of Richard Bingley did not renew the Lowwood Colliery lease in 1763, Rockingham found himself in possession of the Lowwood, Elsecar and Westwood collieries.

Although Rockingham knew little about colliery management, he took an immediate interest in their working and asked for regular fortnightly accounts on output and sales from the overseers, although a prime motive for this interest was probably to prevent embezzlement by his employees. His memoranda and notebooks show that Rockingham took over management of

the collieries determined to raise the revenue from them. The papers also contain comparisons between the cost of producing tiles and bricks at Wentworth and Higham Ferrers, and instructions to find a suitable location close to coal supplies at Wentworth and the turnpike road for the building of a kiln in order to make pan-tiles. He had noted that the cost of manufacturing pan-tiles was much lower than acquiring slates from Bolsterstone. There were calculations on the quantity of coal needed to manufacture a given number of tiles and bricks, and dimensions for a lime kiln at Lowwood. In association with the latter, Rockingham's notes also refer to the carriage of coal from Lowwood to Kilnhurst and the carters returning with limestone, whilst other costs refer to the movement of coal from the Wentworth estate to London. Thus Rockingham was seeking ways to widen the coal market, to stabilise output and raise his mineral revenue.

There are strong indications that Rockingham visited the Duke of Bridgewater's Worsley Colliery, as the notes report a conversation with a Mr Badworth on the price of coal in Manchester, that without the canal would have been 8d per cwt. 'if the work had not gone on' whereas it then was 4½d per cwt. The success of the Bridgewater canal in lowering prices and the cost of transporting coal from the Worsley Colliery into Manchester, appears to have encouraged Rockingham to construct a canal from Greasbrough to the Don Navigation, to serve the Basingthorpe Colliery. As early as 1765, Varley was employed to survey a route, although the canal was not started until 1779, and then after several more surveys. Even so, Rockingham was a proprietor actively concerned in gaining the maximum return from his mineral resources, by seeking wider markets, and lowering transport costs, and obtaining outside advice in the development of his collieries.

The notebooks also show a considerable technical interest in his industrial undertakings, with details on the fall of water from the Lowwood sough to the River Don, notes and calculations on bricking and tiling soughs and a

plan of a coking furnace showing the production of coke over 24 hours from a chaldron of coal. In 1762, experiments were conducted on the extraction of tar from coal, which if successful, would have provided an additional market for Rockingham coal, and considerable revenues.(77)

Although Rockingham may be accused of showing a dilettante's attitude towards his industrial concerns, under more favourable economic circumstances, such as a cheaper method of carrying coal to market, the plans may well have been put into practice. For example, no evidence has been found that a tar distillery was set up. Whilst Rockingham was prepared to take the small Elsecar, Lowwood and Westwood collieries into direct management, he continued to lease the more extensive Basingthorpe Colliery to William and Thomas Fenton. This colliery not only required high cost capital equipment, but considerable mining expertise. The lack of Rockingham's technical expertise was shown in 1774, when Messrs Fenton sought a renewal of their Basingthorpe lease:

> 'I must own too that the concerns are of such a nature, (I mean more particularly the colliery) that it must be a work of time before I could possibly be really so sufficiently master of the subject as to be able to make or accept a proposition.'(78)

There were other, but small, collieries under lease on the Wentworth estate, whose output either supplied the immediate needs of the proprietor or surrounding neighbourhood. The Bolsterstone and Orgreave collieries worked respectively by Michael Fox and William Fenney, supported their glassworks, whilst the Westwood Colliery was leased between 1784-91 to Messrs. Swallow, Machin and Roddis, the proprietors of the Chapel Furnace in Chapeltown.(79) The Westwood Colliery lease was surrendered in 1791, but was later taken over by Longden & Co. of the Thorncliffe ironworks in 1801, after meeting geological difficulties in their own mines. Other lessees included John Jackson, who worked coal at Cortwood, John May who mined coal on Tinsley waste between 1765-86, and John Fisher, Benjamin Swinden and Anthony

Thompson who leased coal at Ecclesall. In Handsworth, Clay, Deakin & Co. paid an annual rent of £80 per acre, whilst the Darnall Colliery in 1780 purchased 12 acres of coal for £1,050.(80)

The Elsecar, Lowwood and Westwood collieries were typical of many on the inland coalfields, where the lack of cheap transport prevented large-scale mining. This was the major factor holding back the expansion of the Elsecar Colliery, as the high cost of carriage by road reduced the geographical market and as a consequence, kept the number of workers to eight by 1778.(81) The limited size of the concern was also reflected in the cost, revenue and profit accounts, which recorded in 1754 an output of 600 pit loads which cost £219-15-5, and with sales amounting to £308-0-0, left a balance of only £88-4-7.(82) However, the limited scale of working the colliery and its shallow depth entailed the minimum of capital expenditure. The major items of expenditure involved sinking shafts, which in 1752 for a pit at Elsecar 15 yards 1 foot in depth, amounted to only £3-16-0 at 5s per yard, plus 2s earnest and drink money on making the bargain. At this colliery, pits usually lasted for 24 months with three shafts being sunk every two years.(83)

The limited output of many inland collieries and the fluctuation in demand, often reduced mining to a seasonal activity, with colliers assisting in late summer with harvesting, ditching and haymaking.(84) The Elsecar Colliery accounts for the 1760's, record several occasions when colliers and their families were engaged in ditching, haymaking and thatching, especially during the months of July and August. Late summer generally reflected a slack time in coal production, as coal stocks were built up earlier in the year, ready for the major coal sales between June and October. At this time of year, roads were at their most passable, and carts and waggons became available after the harvest. The limited markets of many inland collieries, also made them vulnerable to fluctuations in coal

sales. At the Elsecar Colliery for example, the colliers had been laid off for 20 weeks prior to 20 October 1770, but in these circumstances alternative employment was usually available on the estate.

There was a close inter-relationship between the industrial and agricultural activities on the Wentworth estate, for not only were employees transferred from the collieries to work in the fields, but the estate supplied the colliery materials. Timber was used for pit props and whim gins, stone and brick for lining soughs , shafts, constructing workshops and engine houses, and fodder for the pit animals.(85) During the eighteenth century, mining was regarded as one among many activities on the landed estates, and as a consequence, many agrarian traditions were transferred to the collieries. On the Wentworth estate, the agricultural workers were provided with farming tools, food and ale at various times of the year, especially at the harvest. Likewise, the Rockingham-Fitzwilliams also provided their colliers with wedges, candles, shovels, and flannels for wet conditions. The occasional feast was organised for the colliers, and ale provided, especially when a new pit was opened or during wet work, whilst Christmas boxes were given regularly even to those collieries under lease. A surgeon was employed by the estate to care for injured colliers, and regular allowances were paid to widows and employees who were prevented from attending work due to sickness, injury or retirement.(86)

Rockingham increased his mining interest in 1763, when on the termination of the Lowwood Colliery lease, he took the mine into direct management, and purchased the stock for £315-0-0 from the executors of Richard Bingley. The Lowwood Colliery employing seven hewers was worked on a more extensive scale than the Elsecar mine. In 1767, for example, the output at the Lowwood Colliery amounted to 5,401 dozens 6 pulls (11,342 tons), at a total cost of £675-14-10, to leave a balance on sales of £421-0-11, whilst the Elsecar Colliery, in contrast, produced only 1,013 dozens 4 pulls

(2,127 tons) at a total cost of £151-16-9¾, with a balance of £182-2-3. Not only did the Colliery produce more coal, but its average total costs were lower at 2s 6d per dozen, in comparison to those at the Elsecar Colliery at 3s 0d per dozen. By 1781, the position had been reversed with average total costs at Lowwood 3s 0½d compared to 2s 8d per dozen at Elsecar, as a consequence of the increased depth of working as the colliery progressed towards the village of Street. As greater depths were reached the cost of sinking shafts increased which necessitated an extension of their working life and as a result fewer being sunk. In 1781, for example, Benjamin Hall, house steward, wrote that whilst no pits were sunk during this year, '. . . . two are commonly sunk in the course of seven years . . .' By this time a deep pit cost £200 and a bassett pit £120, compared to £17-11-9 for a pit 33½ yards deep at the Elsecar Colliery in 1780.(87)

The Lowwood Colliery could be worked on a larger scale because of its proximity to the Don Navigation. This reduced carriage costs and widened the market for coal. In turn this was reflected in increased output and profits, in comparison to the Elsecar mine, whose development remained static. Although the production costs of the Lowwood Colliery rose between 1768 and 1781, its output almost doubled, whilst at Elsecar, output fluctuated between 960 dozens (2016 tons) and 1,683 dozens (3534 tons). Lowwood profits rose from £689-17-4½ in 1769 to £1,397-10-8 in 1781, whereas at Elsecar, they remained relatively stable around £120 per annum. The development of the Lowwood Colliery was shown in 1782, when Benjamin Hall wrote:

> 'I am also to acquaint Your Lordship that the sale at Lowwood Colliery has been constantly increasing ever since I kept the Accounts w.th is near 11 years and that the 3 last years 12 men have wrought at the works Whereas the preceeding years 9 men have wrought at them.'(88)

However, the distance from the Don Navigation still severely restricted the market for Lowwood coal, as compared with those pits close to the water-

way, for leading coal to Kilnhurst, a distance of 4 miles, added 5s to the cost of 4s 6d for the coal at the pit head. The restricted coal market and low profits did not make it financially viable for Rockingham to introduce high-cost capital equipment such as pumping engines and waggon ways into the Elsecar and Lowwood collieries prior to 1795. At the Elsecar Colliery before 1754, coal was hauled to the surface by a hand gin, and moved from the working places to the pit bottom in wheelbarrows or hand-drawn sledges. In July 1754, Rockingham gave orders for the installation of a horse gin and the purchase of two horses and in January 1769, a 'Brown Mare Rising Six Years old' was purchased for work in the pit. The use of a horse-drawn sledge underground, facilitated the movement of coal from the work places to the pit bottom, and allowed the raising of greater quantities of coal whilst the reduced cost of underground haulage enabled the colliery workings and life of the shafts to be extended.(89) However, these innovations proved the limit of the technological improvements made in the Lowwood and Elsecar Collieries under Rockingham management.

The major investment related to mining before 1795 was made in connection with the Basingthorpe Colliery. Situated at a distance of only 1¾ miles from the Don Navigation, and enjoying lower transport costs, the colliery was worked on a more extensive scale than the mines at Elsecar and Lowwood, and any investment here was more certain to produce a high return on capital expended. In the 1760's the proprietors, Thomas and William Fenton, were already employing 16 hewers, at an annual rent of £648 or £40-10-0 per man and as the enterprise developed, the rents increased to £2,300 in 1781 and £4,893-16-8½ by 1801. The Basingthorpe Colliery was worked on a sufficiently large scale for the introduction of high cost capital equipment, and as early as 1762, there was a waggonway running from the colliery to the River Don near Eastwood lock, and at about the same time, a 'fire engine' was installed, the cost of which was to be defrayed during the term of the lease at 4d per dozen of coal.(90)

Although the Basingthorpe Colliery was located only a short distance from the Don Navigation, it still worked at a disadvantage compared with those collieries lying immediately adjacent to the waterway. Coal sent by the Fentons into Rotherham, sold at the coal stage for 9s per 70 cubic feet (approximately 36 cwt) with the cost of leading between 2s and 2s 8d per waggon. To reduce the costs of transport, Rockingham constructed a canal from the Basingthorpe Colliery to the Don Navigation, which not only enabled the colliery rent to be raised, but provided a regular income as the canal was leased to the Fentons at £500 per annum. Several surveys were made, but work on the canal was not started until 1779, following an estimate from John Smeaton. Rockingham appeared undecided on whether or where to construct the canal, for there was some discussion on whether a waggon way may prove cheaper to use in the long term. A decision to construct the canal was eventually taken after the engineer William Jessop wrote in October 1778, that the usual charge per mile on inland navigation was about 1½d, whilst a waggon way amounted to approximately 3d per ton per mile inclusive of laying, repairs to the waggon way, and keeping the horses. A contract to construct the canal was given to Jessop, with the first payment being made to Jessop and Gott on 24 February 1779.(91) The canal represented the largest single investment in the exploitation of Rockingham's coal resources. A total of £1,950-0-0 had been expended on the canal between February - November 1779 rising by 9 June 1783 to £3,653-0-0, which included excavating the canal, and the erection of lime kilns at Greasbrough. In 1784, Jessop was paid a further £191-3-10½ for the canal reservoir, which increased the total cost of constructing the canal and lime kilns to £3,844-3-10½. This expenditure includes the capital cost of the canal, as far as possible, after the deduction of transfer payments such as damages and exchange of land. The exact date of its opening is uncertain, for although the first rental of £300 was due on 1 January 1784, Thomas Fenton paid £5-5-0 on 26 November 1784 towards liquor for the watermen and colliers on opening the canal.(92)

By leasing the Greasbrough Canal at £500 per annum, Rockingham was able to retrieve the original capital outlay within eight years, and in anticipation of its opening, the Basingthorpe Colliery rent was raised in 1779 from £648-0-0 to £2,300-0-0 on renewal of the lease. Although the rent was substantially raised, Michael Hague calculated in 1790, that on the 18,500 waggon loads allowed to be worked annually, the lessees could still receive £1,526-0-0 clear profit,(93) which made the Basingthorpe Colliery one of the major mining concerns in South Yorkshire. The construction of the Greasbrough Canal illustrates how the wealth of a great landowner was able to assist in the development of his minerals, for it was unlikely that Messrs. Fenton would have been able or prepared to raise sufficient capital for the project.

On the death of the Marquis of Rockingham in 1782, the vast Wentworth estate went to his nephew, the 4th Earl Fitzwilliam, who was able to carry out the large-scale exploitation of the mineral resources. Initially Fitzwilliam lacked the technical knowledge and experience of colliery management. This was revealed in a letter to Benjamin Hall, his house steward, on 18 February 1783:

> 'I return to you the inclos'd draft of agreement for sinking a new pit at Lowwood Colliery, of which I am not a competent judge, & therefore leave it entirely to your experience.'(94)

Why then did Fitzwilliam choose to continue with the direct management of the estate collieries? According to Mee, to have leased the Lowwood, Elsecar and Westwood collieries would have involved a radical change in policy, and Fitzwilliam may have felt it his duty to develop the minerals, not only for profit, but for the common good, to keep full employment, and prevent the spoliation of the estate. As evidence of Fitzwilliam's profit motive, Mee cites the exploitation of the 6 feet 9 inches Parkgate and 9 feet Barnsley seams before the thinner coals.(95)

It is doubtful whether the desire to protect the estate from mining damage played any significant part in persuading Fitzwilliam to continue with the direct management of the collieries, as this could have been averted by strict leases, regular reports from viewers and vigilance by the estate stewards, as was the case with the very extensive Basingthorpe Colliery. Even the suggestion that Fitzwilliam worked the collieries for the common good and benefit of the national economy, could be interpreted as a rationalisation of his economic and political dominance in the area. It was also unlikely that deference to his uncle would have been carried as far as investing such huge capital sums in the collieries. Furthermore, as the collieries in 1782 were worked on a small scale and contributed an insignificant part of the total estate revenue, there would have been no strong inclination to retain their management out of respect for tradition. This was borne out in November 1782, when Fitzwilliam seriously contemplated leasing the Lowwood Colliery after an offer had been made by Messrs. Fenton, but on receiving a statement of the profits over the previous seven years, this was rejected. While the reasons given by Mee may have contributed in part towards the Earl continuing the management of the collieries, profit both real and potential was probably the major motive. As Mee states, the development of the thicker seams does show a profit motive. It was prudent to exploit these seams when mining involved such high risks and therefore the coal that promised the best returns would see the initial investment. In fact the real reason why Fitzwilliam developed the nine foot Barnsley seam at Elsecar, was the proposed construction of the Dearne and Dove Canal, with its branch to Elsecar, and the intention of Darwin & Co. to open ironworks adjacent to the new colliery, which promised to open up vast new coal markets. However, by 1793, the condition of the Lowwood and Elsecar collieries would have made it difficult to attract suitable lessees on account of serious drainage problems, due to the poor state of the soughs, whilst

further coal reserves had to be broken into to enable the continued working of the Lowwood Colliery.

In 1782 when the 4th Earl inherited the Lowwood, Elsecar and Westwood collieries they were still small concerns incorporating few technical innovations. At the Elsecar Colliery for example, the coal was worked at the shallow depth of 33½ yards and hauled along the roadways by a mare first used in the pit some 13-14 years before. The whim gin that wound the coal to the surface had been working for 26 years. Even as late as 1793 a plan of the colliery drawn by Joshua Biram, showed that a similar method of transporting the coal was still in existence, and on the surface a horse-drawn sledge carried the coal from the pit head to the coalstack. In spite of the lack of capital investment and an increase in average costs between 1782-93, the profitability of the collieries increased under Fitzwilliam management. As a consequence the combined 'balances' of the Lowwood and Elsecar collieries rose from £1,150-13-1½ in 1781/2 to £2,022-17-10 by 1792. Even so, Fitzwilliam was sufficiently concerned about the condition of the Lowwood Colliery in 1790, to employ the services of the viewer John Stephenson, of Walker's Kimberworth Colliery, to report on the condition and future method of working the mine. On the Lowwood and Elsecar soughs, Stephenson commented that:

> 'The Low Wood Sough has long been of little worth - vends but a small Quantity of Water at the Foot it breaks out above where it can find Room - The Elsecar Drain is below that in bad order too & below the Tail there is yet more fall - '(96)

Not only were the colliery soughs in a poor condition and posed a danger to future working, but the Lowwood Colliery had to acquire further coal reserves without running the risks of draining other proprietors' minerals. Stephenson advised against accepting a proposal made by Fitzwilliam's competitors to form a joint enterprise to work the coal. Instead he suggested that Fitzwilliam acquired the Southwell Colliery lease, extended its

levels to Lowwood, purchased the Lund and Robert estates to 'lock up' the competitors' coal, extended the Lowwood workings and carried the sough up the Elsecar valley to drain additional coal.

The market for coal in 1790 was such that Stephenson decided against opening a new colliery, as there was a serious doubt whether sufficient sales could be achieved. It was probably with the aim of extending the sough along the Elsecar valley that three bore holes were driven to the Barnsley bed, the first at 230 yards from the Lowwood level with the second and third at 170 yards and 150 yards respectively from the first bore hole, and running in a north-east direction. The first two bores reached coal at depths of 24 yards and 34 yards, whilst the third struck a fault, throwing the coal down 25 yards. Following calculations made by Michael Hague, manager of the Elsecar Colliery, it was estimated that a sough one mile in length, driven from the second bore hole and running parallel for 400 yards to the old drainage level, would drain 145 acres of coal.(97) This not only shows the geological expertise of the Elsecar Colliery managers at this time, but also reveals the intended scale of working envisaged by an extension of the collieries.

The 1790's marked a watershed in the development of the Fitzwilliam collieries, for whatever scheme was adopted, considerable capital expenditure was needed to enable them to continue production. It was decided to open a new colliery at Elsecar, a decision almost certainly brought about by an improvement in the coal market, and the attainment of the royal assent on 3 June 1793, of the Dearne and Dove Canal Bill. The canal promised to lower the cost of carriage and greatly extend the Fitzwilliam coal market, whilst a further encouragement to open a new colliery was the intention of Darwin & Co. to construct an ironworks at Elsecar. The considerable investment made by the Fitzwilliams in the exploitation of their coal resources

commenced in July 1794, with the sinking of the engine and bye pits of the Elsecar New Colliery. John Deakin, the colliery viewer was employed in December 1793 and given over-all supervision of the new colliery, to be assisted by Michael Hague, manager of the Elsecar Old Colliery.(98)

Prior to sinking the colliery, bore holes were sunk to ascertain the extent of the coal, its depth and direction of the fault. Although it was usual to hire a private company of borers, much of the work was done by the existing work force, especially Michael Hague's son and brother John Hague. Most of the colliery materials came directly from the estate or its lessees, a brick kiln was constructed to supply bricks for the pits, to supplement the production of the Lowwood brickworks, stone came from Simon Wood and a new quarry was opened in Lowwood. In December 1794, the accounts recorded that: 'John Falding & Samuel Sykes for Meal &c &c. for an entertainment for Masons, Carpenters &c. at 'rearing the Engine House' 4.10.4.'.(99) Michael Hague was paid £276-16-0 for sinking the engine and bye pits with the coal being reached in December 1794 at a depth of 35½ yards. In the same month, William Sellors & Co. received £8-8-0 for making a sump 3 feet 6 inches below the coal and for finishing the engine pit, and by September 1795, George Sellors & Co. had driven the boardgate a distance of 20 yards at 3s per yard, to link the engine and bye pit .

The Newcomen engine completed in September 1795 under the supervision of John Bargh, engineer, was the largest single item of expenditure. Parts for the engine manufactured locally, amounted to £1,060-18-11, to which must be added the cost of building the engine house, workshops and bridge near the engine of £285-0-5½.(100) The Elsecar New Colliery started production in September 1795, with Charles Bowns, land agent, writing in November that: 'It is with great pleasure that I inform Your Lordship that the Elsecar Colliery promises to be the best Mr. Deakin ever saw . . .'(101)

Whilst the initial outlay in opening a working colliery at Elsecar was relatively low, amounting to £2,663-1-0 between April 1794 - December 1795, this represented only the start of annual expenditures on rails, steam winding engines and colliers' houses. The intention appears to have been the opening of a working colliery as soon as possible, to obtain a return on capital expended, and install later the more costly capital equipment as the market and colliery developed. Further investment and a rise in output followed the completion of the Dearne and Dove Canal to Elsecar in 1798, and the opening of the Milton ironworks in 1802, which partially accounts for the total expenditure on the Elsecar New Colliery from January 1796 - December 1806 amounting to £23,395-19-7¾.(102)

Apart from the Newcomen engine, the major items of capital expenditure were not installed until after 1795. On the colliery opening, coal was hauled to the surface by a horse-drawn whim gin, but in September 1796, this was replaced by a steam-driven whimsey erected by Jonathan Woodhouse, engineer of Ashby-de-la-Zouch. Cast metal goods for the whimsey to the value of £158-8-7½ were supplied by Jarratt, Dawson and Hardy of the Low Moor Ironworks near Bradford, and a steam boiler costing £45-15-1½ from Darwin & Co., bringing the total cost for making and erecting the whimsey to approximately £248-10-11. By 1796 conductors, invented by John Carr, had been installed, a tramroad constructed, two tiplers purchased from Phipps, Clay and Deakin, proprietors of the Darnall Colliery, and corf and waggonway patterns had been sent from Flockton. The completion of the Elsecar branch of the Dearne and Dove Canal coincided with a further period of investment with orders given in March 1799 for:

> 'The Pit Top at Elsecar New Colliery to be raised 12 feet and a double Rail Road laid from thence into the Bottom of Simon Wood about 10 yards to the East of the Engine tenders House and from thence a single Road upon standards and Rollers with movable Tiplers

for putting Coals into a Battery according to a Plan delivered to John Falding by Mr Deakin.'(103)

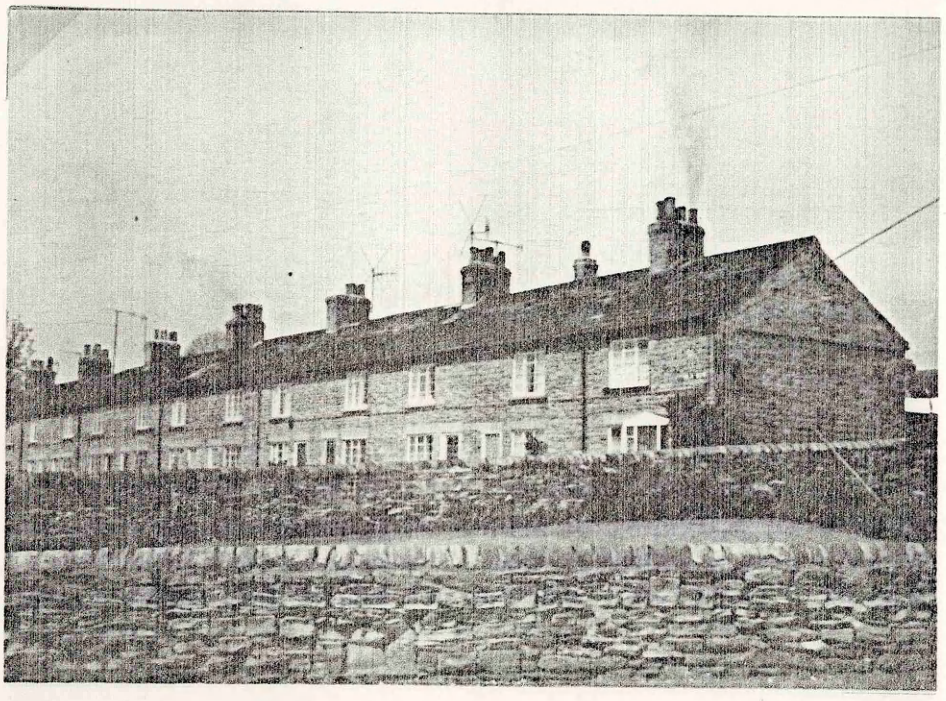
Another pit was sunk in 1798, with a steam whimsey supplied by Jarratt, Dawson and Hardy. The Newcomen engine was modified, as the cylinder was found to be too small, and when the colliery flooded following a breakage of the lower clack in the pump in 1801, a new 48" cylinder was installed by the Butterley Ironworks at a cost of £189-9-0.

In order to exploit new reserves of coal, further capital investment was carried out at the Lowwood Colliery, but not before some discussion on whether to abandon the mine. A pit was sunk in 1797, with a steam winding engine costing £303-7-5½, new levels were driven, and shortly after 1800, a pumping engine was installed both to raise the increasing quantity of water entering the workings and to drain the deeper coal.

Investment in the Fitzwilliam collieries directly benefitted the local ironworks, especially those on the Wentworth estate, such as the Thorncliffe and Elsecar companies, and after 1803, the Milton ironworks. Iron goods to the value of £2,298-8-1 were purchased by the Elsecar New Colliery between 1796 and 1800, whilst at the Lowwood Colliery this amounted to £1,072-11-8 between 1797 and 1800. Expenditure on iron rails alone came to £1,364-5-8½ or 9.5 per cent of total costs between 1799 and 1801 at the Elsecar New Colliery. In addition to the local ironworks, orders were placed with the Butterley works in Derbyshire and the Coalbrookdale concern in Shropshire. There was a tendency for general castings to be purchased locally, and the more precision engineering goods, such as cylinders, acquired from outside the Wentworth estate.(104)

An obstacle to colliery expansion in areas of low population, as Elsecar, was the difficulty in recruiting sufficient labour. To attract employees, colliery proprietors were often obliged to provide houses, with subsidised rents, which could involve considerable capital expenditure.

STATION ROW, ATTRIBUTED TO JOHN CARR OF YORK ARCHITECT. BUILT BETWEEN 1795 AND 1801.



OLD ROW. BUILT BETWEEN 1795 AND 1801.

REFORM ROW. BUILT 1837.

COLLIERS' HOUSES IN ELSECAR BELONGING TO EARL FITZWILLIAM Fig. V.

Charles Bowns, land agent, in a letter to the Earl on 27 May 1792, commented on the scarcity of colliers at Elsecar and the need to put themselves to 'some inconvenience to procure them...'(105) He went on to state that a certain John Lindley who had worked previously at Lowwood was prepared to leave Attercliffe Colliery to work at Elsecar, if accommodation could be found for him. Bowns suggested that Lindley could move into some property that was about to be converted. The opening of the Elsecar New Colliery in 1795 increased both the demand for labour and the need to provide accommodation. To meet this need, between 1797 and 1798, Fitzwilliam built, converted or repaired at least 42 dwellings, costing approximately £1,556-14-11¾. On completion of the Rainber Park Colliery in 1818, six dwellings were erected costing £700-4-0½, and for the New Park Gate Colliery accommodation amounting to at least £550-17-10¼ was provided in Rawmarsh and Greasbrough.(106)

There was a direct relationship between the level of investment in the Fitzwilliam collieries and fluctuations in the coal market. The boom in the coal trade in 1809-10, was reflected in increased purchases of iron rails at the Elsecar New and Lowwood collieries to the value of £426-12-6 and £287-9-1 respectively. A whimsey was installed at the Lowwood Colliery in 1809, costing £609-13-1 with the total expenditure on iron goods reaching a peak in 1810. On the other hand, the post war depression saw a decline in investment particularly at the Elsecar Old Colliery, where expenditure on iron goods fell from £326-11-9 in 1816, to £30-6-2 by 1819, and even the Elsecar New Colliery witnessed a considerable decline in purchases.

Although the period between 1793 and 1804 involved Fitzwilliam in major expenditures on his collieries, these were overshadowed by those carried out after 1818, following a revival in the local coal market. As the iron industry adapted to peace time conditions and developed new and

more stable markets, the coal industry was able to expand at an even greater rate. To take advantage of the resurgence in the iron industry and the more distant markets created by the Chesterfield, Sheffield, and Stainforth and Keadby canals, Fitzwilliam turned to the exploitation of his coal reserves in the Greasbrough-Rawmarsh area. In so doing, the Wentworth estate became the largest producer of coal in South Yorkshire. Once the slump in the coal trade had passed its cyclical trough in 1817, and in anticipation of a more buoyant market, Fitzwilliam opened the Brampton Colliery in November 1818, although full production was reached only in 1820, as the market improved.(107) The colliery was a small undertaking with no entries in the accounts for pumping engines or steam whimseys and a sough was probably the only means of drainage, as this accounted for much of the original expenditure. The initial low level of investment in the venture kept any possible loss to a minimum if the colliery was not a success. There was further investment in 1820, following an improvement in the coal market and output, with the largest single item of expenditure on the construction of a waggon road from the pit head to the Dearne and Dove canal, amounting to £1,181-18-0¾, including metal castings to the value of £1,050-17-3½ supplied by Darwin & Co. By 1824, Fitzwilliam was charging himself 4.6 per cent interest on the £4,300 of capital which he had expended, which had risen to £5,300 by 1827, after the erection of six dwellings and a stable. Another small colliery was opened in March 1823 at Swallowwood, but until 1829 it produced no more than 5,500 tons per annum. Both the Swallowwood and Rainber Park collieries suffered severely from the general economic depression of 1827-8, with their respective outputs declining from 5260 tons and 13,862 tons in 1826 to 591 tons and 1368 tons in 1828. However, the depression was short-lived at the Swallowwood Colliery with record output levels achieved in the following year.(108)

On the termination of Messrs. Fenton's lease of the Basingthorpe Colliery in 1818, and their withdrawal from mining in the area, Fitzwilliam was free to exploit the Greasbrough coal and take advantage of the demand from the rapidly expanding iron industry in Rotherham and Sheffield. With this market in mind the New Park Gate Colliery was opened in June 1823 which was able to take advantage, some four years later, of a major ironworks established at Park Gate. This colliery accounted for the largest single mining investment made by the Wentworth estate between 1750 and 1830, and reflects the aggressive attitude and determination of Fitzwilliam to exploit his minerals, and dominate coal production in South Yorkshire.

The New Park Gate Colliery took three years to complete from the first entry in the accounts in August 1820, and by 1827 capital expenditure had reached £32,000, with a further £33,000 on the purchase of freeholders' coal. The sinking of the colliery once again provided major contracts for the local ironworks, with orders for iron goods amounting to £4,409-14-10 by December 1823, or 17.2 per cent of total expenditure, which rose to £10,193-5-1¾ by the end of 1827.(109) The 'Great Engine' alone cost £2,157-8-9 with castings supplied by four companies, all local except for a major contract from the Coalbrookdale Company. A dry dock was constructed to build and repair boats, a basin to accommodate craft on the Greasbrough canal and running from the pit head to the canal wharf was a waggon road 580 yards in length, costing £699-1-6, whilst in 1827 a 'wind up Engine & machinery' were purchased from the Butterley Company at £1,318-17-7.(110) As a result of this continued investment, output was able to rise to 45,136 tons by 1828, to rival the 44,839 tons produced at the Elsecar New Colliery.

The investment of approximately £38,600 in the Park Gate, Swallowwood and Rainber Park collieries between 1818 and 1830, assisted in raising the total output of Fitzwilliam coal from 55,468 tons in 1818, to 141,806 tons

when the figures become inaccessible
in 1826, representing an increase of 156 per cent over the period. Although the rise in output came largely from the new collieries, the Lowwood and Elsecar Old collieries also experienced a rapid increase in output, especially the latter, whose output rose from 3,002 in 1780 to 27,692 tons by 1825, due to demand from the Milton ironworks. There was a corresponding rise in the number of colliers employed, from no more than 38 in 1770 at three collieries, to 317 at six collieries in 1828.(111)

As a colliery proprietor, Fitzwilliam not only opened new collieries and extended old mines, but was called upon to purchase freeholders' coal and competitors' collieries. To enable the extension and continued working of the Lowwood Colliery, the adjacent Matthew Robert's estate was purchased in 1795 for £5,250-0-0, followed in 1804 by the acquisition of coal in the Francis Lundy estate for £1,050-0-0. The purchase of the Cortworth Colliery for £905-1-1 from Schofield, Longden, Morton and Hill in 1804, not only provided additional coal for the Lowwood mine, but removed a competitor.(112) Although the Wentworth estate was relatively compact, some freeholders' property was interspersed with Fitzwilliam land, and as the colliery workings moved outwards, it became increasingly necessary to purchase their coal. By 1813, annual payments were being made for freeholders' coal in the Elsecar area of £1,196-19-2, but around Greasbrough the number of landowners made working the coal difficult without the acquisition of the mineral rights by a single proprietor.(113) Even an exchange of land had its disadvantages. This was indicated in January 1786, when a Mr Foljambe suggested an exchange with Fitzwilliam to prevent inconvenient disputes in case a colliery were sunk. On consideration of the proposal, John Kent and Michael Bisby advised Fitzwilliam against the scheme, as it would not only allow Mr Foljambe to erect a 'fire engine' that would drain his estate at Rawmarsh at a lower cost, but would also intercept the sale of Fentons' coal and injure the Lowwood Colliery '. . . by being two Miles and a half nearer to the County into which a great Part of the Coals from

thence is vended.'[114] It became imperative to purchase the freeholders' minerals after the opening of the New Park Gate Colliery, whose workings lay in direct line with the properties of Messrs. Stevenson, Blakey and Foljambe. An agreement was eventually arranged to purchase their coal. By 1829 the cost of this had reached £33,000. The purchase of freeholders' coal became a major item of expenditure, adding to working costs and the risks of the enterprise. However, without Fitzwilliam's capital, the Greasbrough coal may not have been exploited until much later in the century, as it was doubtful whether there was any other proprietor available with the necessary capital. Even the Fenton family, who had mined coal in the area between 1737 and 1827, had withdrawn from mining in South Yorkshire.

Fitzwilliam also purchased freehold coal to facilitate the drainage of his existing collieries and overcome competition. The major competitors of the Lowwood and Elsecar collieries, were the Southwell or Rawmarsh Colliery of Mr Cartwright and the Haugh Colliery worked by Mr Kent, which enjoyed lower transport costs since they were located nearer the Don Navigation. Fitzwilliam was particularly concerned about any future lessees of the Southwell Colliery. The mine appears not to have been worked regularly and another lessee may have developed the concern to the detriment of his collieries. In 1784, for example, Michael Bisby warned the Earl of the danger of Messrs. Walkers' acquiring the lease:

> '... the which will be a disadvantage to the Lowwood Colliery, as their works will be immediately in the way of the sale, and I can't think of anything that will be an inducement for the buyers to come forward to Lowwood when the Coal will be nearer to them and equally as good as that of your Lordships . . .'[115]

Fitzwilliam made several unsuccessful attempts to acquire the Southwell Colliery before it was eventually secured in 1810. The acquisition of the

Southwell lease also assisted in alleviating the large quantity of water that regularly poured into the Lowwood and Elsecar collieries from the old Southwell workings. This view is further reinforced, when immediately on taking over the lease, some £444-0-1½ was expended on opening an old and driving a new sough, to be followed in 1812 by yet another, driven this time from the Lowwood to the Southwell Colliery. Although the Southwell mine had by then ceased working, Joshua Biram suggested keeping the lease '. . . to prevent a rival colliery. . .' gaining the coal.(116)

On 14 April 1819, a further large purchase was made of the estates of W. W. Kent at Haugh and Rawmarsh, which included the land for £20,976, minerals for £6,000 and the Haugh Colliery for £460-9-6. The vendors aptly summarised the benefit of acquiring the minerals, in that its purchase would give Fitzwilliam the whole 'command' of the coal in Rawmarsh. In fact it was John Stephenson some 20 years before, who had suggested that Fitzwilliam should purchase the Southwell and Haugh collieries which could be worked together, and give him control of the coal in the area. Thus the purchase of these collieries added further reserves of coal, strengthened the Fitzwilliam coal monopoly, locked up other landowners' coal and eased the flow of water into the Lowwood Colliery.(117)

In common with many other collieries who suffered from the inflation caused by the French Revolutionary and Napoleonic wars and rising expenditure through the working of deeper coal, the collieries under Fitzwilliam management also experienced rising production costs. Wage costs remained the largest single item of expenditure, although the wage cost per ton varied to a considerable degree at the various collieries, with the lowest recorded at the Elsecar and Lowwood collieries. Costs remained relatively stable between 1768 and 1789, but thereafter rose steeply to reach a peak in 1812.(118) It is noticeable that wage costs per ton rose

during periods of depression, due to a reluctance to dismiss colliers, which reflects both a paternal attitude to their workers and a reluctance to dismiss skilled labour, as this was difficult to obtain during periods of high demand for coal. The landed proprietor was able to re-deploy labour in other estate activities, an option not open to the capitalist proprietor.

It was the rapidly rising costs involved in opening and maintaining collieries without the guarantee of favourable returns that persuaded many landed proprietors to revert to the position of lessor. Coal mining was increasingly left to those businessmen better able to raise capital and bear the risks of management. Not only did wage costs rise as the deeper coal was exploited but the capital costs also increased. At the New Park Gate Colliery, for example, the 'Great Engine' alone cost £2,157-8-9. However, the profitability of the collieries under direct management was sufficient to encourage Fitzwilliam to remain a colliery proprietor and even extend his mining enterprise in the 1820's. A major difficulty in calculating the level of real profits after 1780 is the non-availability of figures that take into account the rate of inflation, and thus in the light of this the calculations given below are in money terms only. Once the collieries were taken into direct management, Rockingham and Fitzwilliam quickly increased their profitability, with the Lowwood Colliery for example, raising its profits from £421-0-11 in 1768 to £1,583-7-0½ in 1784. Between 1801 and 1828 the number of directly managed collieries increased from three to six, and the total balance rose by 171 per cent. As measured by the accounting criteria of the time, the collieries would have been looked upon as highly profitable concerns, and this gives a possible explanation for the investment of the 1820's. In comparing the total balances at each colliery between 1803 and 1807 and 1816 and 1820, the Elsecar New Colliery rose by 21 per cent and the Elsecar

Old Colliery 79 per cent, with only the Lowwood Colliery falling by some 5 per cent. The income from Fitzwilliam's coal reserves also comprised an increased proportion of the total estate revenue. In 1768, the aggregate colliery balances amounted to only 6.70 per cent of the total estate revenue, but by 1801 this had increased to 19.83 per cent, and in 1820 to 26.69 per cent. However, if the 'expenses' item is deducted from the 'balances', the proportion of colliery income to total revenue declines respectively to 6.70, 10.86 and 13.36 per cent.(119) The balances of the collieries were also looked upon as profit and recorded as such in the 'Household General Accounts' which omitted the 'expenses' item. However, Fitzwilliam did look at the overall view of the collieries with 'net profit' seen as the aggregate of their 'balances' minus the aggregate 'expenses'. It is what Fitzwilliam looked upon as profits which is important in gaining some insight into why he continued in the role of colliery proprietor, instead of reverting to the position of lessor like many of his contemporaries.

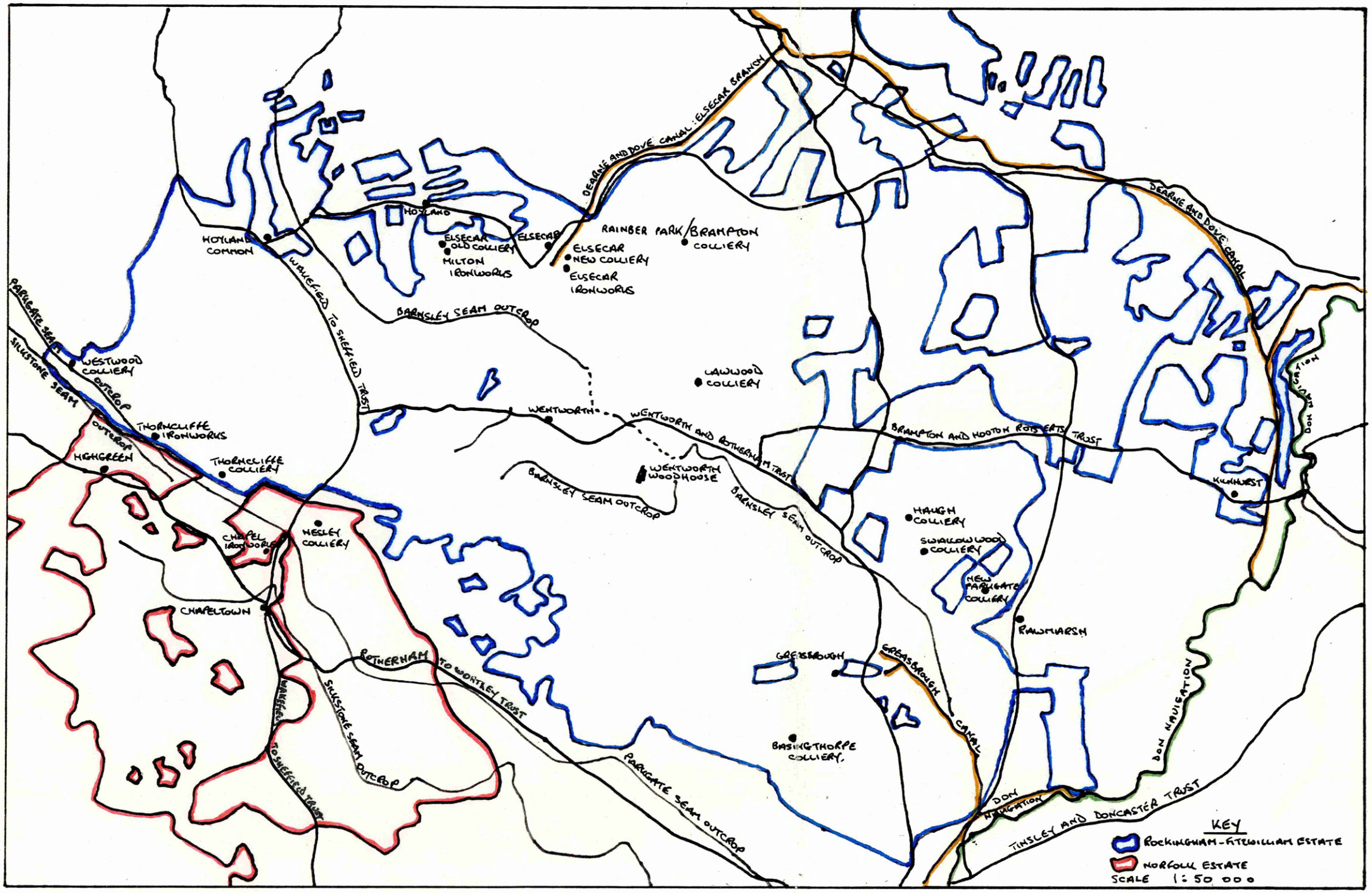


Fig. VI.

COLLIERIES ON THE WENTWORTH ESTATE 1750 TO 1830.

CHAPTER FOUR

TECHNOLOGICAL INNOVATIONS AND MINING TECHNIQUES

Large-scale colliery development between 1750 and 1830 called for the introduction of technological innovations. As collieries were more extensively worked, the movement of coal from the coal face to the pit hill and point of disposal, became increasingly prone to interruption and bottlenecks at the various stages of transportation. Furthermore, working at much greater depths raised the additional problems associated with drainage and ventilation. It was in the solution of these logistical and engineering problems that the landed interest made a significant contribution to the long term expansion of the coal industry.

The varied nature of the Norfolk and Rockingham-Fitzwilliam manuscripts has largely determined the approach to this chapter. This has meant that the almost total lack of evidence on pit sinking in the Norfolk manuscripts has resulted in the omission of a section on this subject for the Sheffield collieries. Whilst the inbalance in documentary evidence accounts for the Norfolk collieries making a greater contribution to the chapter, a further consequence of the differences in source material is that the chapter has been divided into three sections. The first section outlines the national developments in coal-mining technology and innovation, and includes the sinking of pits, methods of extracting the coal, drainage, ventilation, lighting, underground haulage and winding, and surface haulage. The bulk of the chapter consists of how the Norfolks and Rockingham-Fitzwilliams attempted to solve the problems associated with large scale mining, and for this the two estates will be studied separately. This approach will also allow a more specific study of the contribution of John Curr to the advance of mine engineering during the last 25 years of the eighteenth century. The final section or conclusion to the chapter will emphasise comparisons and contrasts between the two estates.

The Major Technological Developments and Innovations in Coal Mining 1750-1830

Prior to the sinking of a pit, borings were taken to ascertain the presence of any obstacles such as faults, and the depth and thickness of the coal. In both the operations of boring and pit sinking, few innovations were introduced during the course of the eighteenth century. Boring was done with rods that were forced through the strata by hand until the desired depth was reached. The introduction of gunpowder was the major innovation adopted in pit sinking which enabled the workers to blast an opening through hard rock. In the North East of England a four-sided pit was initially cut in the surface soil to become an octagon shape towards the stone, through which the shaft was changed to a circle. The sides of the shaft were lined with stone, brick or deal boards, except when it passed through stone, where it was left unlined. The problem of stale air was partially overcome by carrying air pipes down the shaft through which fresh air was pumped. As with the borers, wage rates for the sinkers were generally calculated according to the depth of working, with additional payments for hard rock or wet conditions.(1) In the smaller collieries the sinkers were usually employed as hewers when pit sinking was not in progress.

Once the necessary shafts had been sunk, headings or roadways were driven to the coal face. Although no significant improvements were introduced in the method of ripping the coal from the working face before the introduction of mechanical cutting machines in the 1850's, the adoption of longwall mining proved to be one of the major technical developments in the history of coal mining. Prior to the widespread acceptance of longwall mining the pillar and stall method of working the coal was the most common in the eighteenth century. Headings were driven along the grain of the coal from which bords or stalls were cut at intervals. The stalls were approximately 3 yards wide and separated by pillars of coal 4 yards square.

The major disadvantage of this method was that only 50 per cent or less of the coal could be extracted, but as the eighteenth century progressed the introduction of longer and narrower pillars enabled more of the coal to be worked.(2)

A further boost to output was achieved following the widespread adoption of longwall mining from its origin in Shropshire in the seventeenth century. It reached the northern coalfields during the second half of the eighteenth century assisted by miners brought in from Shropshire. This method enabled the collier to remove most or all of the coal, for as the working face of up to 100 yards in length was pushed forward, the 'gob or goaf' behind was packed with waste on which the roof was allowed to settle, thus eliminating the need to leave pillars of coal. However, over the period under study it was accepted that the method was only suitable for thin seams or where the strata at either side of the coal was hard, which in effect, made its introduction patchy throughout the coalfields.(3)

Longwall mining also brought about a change in work practices and an increase in efficiency, for whereas the pillar and stall method only allowed colliers to work in pairs in each stall, the new system enabled companies to extract the coal in such a way as to provide a greater division of labour. As one set of workers notched the bank or coal face, hewers with wedges brought down the coal to be broken into manageable pieces for the fillers to load into corves, which were then led by hurriers to the pit bottom. It was usual in the Lancashire, Yorkshire and Midland coalfields for a company of six or eight men to work a pit and deliver the coal to the owner at a price agreed between the gang leader and proprietor.(4)

The scale on which a colliery could be worked was usually determined by the ability of the proprietor to drain the workings. The most common method of drainage was by sough, whereby a tunnel was driven at a slight gradient upwards into a valley side to meet the coal seam. Where the sough entered

the coal a water level was driven along the level contour of the seam to allow the water to pass from the workings into the sough and eventually out of the colliery.(5) The dimensions of the sough were kept as small as possible to reduce the costs of construction. At the Orrell House Colliery, for example, the sough measured only 2 feet 6 inches wide and 4 feet 6 inches high. As the need to extract the deeper coal became more imperative the length of the sough correspondingly increased.(6) The construction of a sough was long and arduous work and whilst gunpowder was used, it added to the dangers involved in working in such confined spaces. Colliers had to work in wet conditions with the ever present threat of being crushed by a roof fall or overcome by gas. To prevent the roof collapsing over a period of time, soughs were lined with brick or timber and their regular maintenance was of paramount importance to the continued working of a colliery. It was not surprising that colliery leases laid particular stress on regular maintenance as a means of protecting lessors capital and future rents. It was tempting for the lessees to let the soughs fall into disrepair, especially towards the end of a lease, due to the costs involved.

Soughs enabled the extraction of the shallow coal only, and as this was rapidly becoming exhausted by the early eighteenth century, especially in the Northumberland and Durham coalfield, it was vital that an alternative means of drainage be introduced to enable the deeper coal to be worked. Several mechanical devices were introduced during the seventeenth century, such as the rag and chain pump, and the bucket pump driven by a water wheel, but these again could be employed only in shallow mines.(7) The problem was not overcome until the introduction of Newcomen's atmospheric pumping engine, which revolutionised colliery drainage.(8) This innovation enabled the previous unworkable deep coal to be extracted and gave a new lease of life to those collieries whose shallow deposits were close to exhaustion. The Newcomen engine also lowered drainage costs. This was reflected at the Griff Colliery, Staffordshire, where prior to the erection of an engine in

1714 some 50 horses were used to raise the water costing at least £900 per annum, compared with the annual cost of the Newcomen engine which did not exceed £150 per annum.(9)

The date and rate of the introduction of Newcomen engines varied from area to area. The first engine was erected in the Great Northern Coalfield in 1714. This compares with 1769 for the Orrell Coalfield at the Orrell Hall Colliery. The cost of the engine prevented its purchase except by the larger collieries, which accounts for its slow adoption on the inland coalfields where mines were generally worked on a small scale.(10) A more efficient steam pumping engine was introduced by Boulton and Watt in 1775, although the colliery proprietors were slow to adopt it, preferring instead to install the Newcomen engine. As late as 1795 Earl Fitzwilliam preferred to erect a Newcomen type engine in the Elsecar New Colliery. The continued use of the Newcomen engine was due to its ability to burn low grade coal that the collieries found difficult to sell. Furthermore engine maintenance was easy, in the sense that it could be undertaken by relatively unskilled labour. Therefore, the two-thirds saving on fuel of the Boulton and Watt engine was not necessarily an advantage to the colliery proprietor.

Two further problems associated with mining were concerned with ventilation and lighting, as colliers had to face the ever present danger from such gases as chokedamp or carbonic acid in the shallow mines and the additional danger from firedamp, methane or marsh gas in the deeper collieries. Numerous practices were employed to rid the workings of gas, although none of these were entirely satisfactory. They included placing fire baskets in the shaft to create a movement of air, or igniting the gas by a man clad in rags carrying a long pole on the end of which was fastened a lighted candle. An alternative method involved drawing a trolley, on which was a candle, through the gas with the aid of ropes.(11) Bellows were also used to blow fresh air into the workings through long pipes, and if the colliery was

located on a valley side atmospheric pressure could be exploited to create a movement of air.[12] In some collieries air pipes connected to the furnace were taken to the coal face to draw off the foul air.

The most common practice in the eighteenth century, and the most efficient, was to place a fire pan at the bottom of a shaft to cause a movement of air down the winding-shaft through the workings and up the ventilation pit. However, as the underground workings became more extensive, there was a greater opportunity for gas to collect in the old work places, or remote parts of the mine, from where, as a result of roof falls and changes in atmospheric pressure, it could seep into the working areas. This was to a large extent overcome by Spedding in 1760, who introduced into the Whitehaven collieries a method of coursing the air by trap doors into the more remote parts of the mine. Explosions from overloaded gaseous air passing over the furnace were reduced by dividing the air current into two, each ventilating a part of the mine, whilst a dumb drift prevented the foul air coming in contact with the furnace.

A more intractable problem was concerned with lighting, for which several unsuccessful innovations were introduced. The most common method of lighting was by naked candle and oil lamp, which as the mines became deeper and correspondingly more gaseous, caused more serious explosions. This brought forward a rush of innovations to solve the problem, from working by the luminescent light of putrefying fish to the steel flint mill.[13] The eventual solution had to await the introduction of the safety lamp by Humphry Davy in 1816. However, its benefits were lessened by miners unscrewing the top to achieve a brighter light, and proprietors not generally insisting on its use.

The advances in the coal industry brought about by the introduction of longwall mining, and improvements in drainage, ventilation and lighting, enabled collieries to be worked on a more extensive scale. This in turn

meant that greater quantities of coal had to be moved more quickly from the coal face to the pit hill or point of disposal. During the early years of the eighteenth century coal was carried on the backs of men and women or in wheelbarrows, especially in the small collieries, whilst in the deeper and more extensive mines along the Tyne and Wear, barrowmen or putters dragged corves on sledges attached to oak or ash runners.(14) Heavier loads could be carried, following the introduction of horses and ponies underground in the 1760's. There was no standard measure or size of corf which varied over a period of time and from area to area and even between collieries owned by the same proprietor. In addition, the general practice of calculating coal by measure instead of by weight further complicated the problem of producing accurate output statistics.(15) The relatively flimsy hazel wickerwork basket corves used in many collieries slowly gave way to solid wood and metal corves, which were advocated by engineers such as John Curr in the 1780's.

The introduction of wooden rails underground greatly facilitated the movement of sledges after 1765, especially when plateways and four-wheeled sledges were adopted. One of the major innovations was brought about by John Curr who introduced the four-wheeled corf in the 1780's, but more of this will be explained later in the study. One adverse consequence of the introduction of horses underground was the increased employment of relatively cheap child labour as previously manual haulage was too strenuous for all but the adult worker.

The improvements made in underground haulage would have been to little avail, without similar advances in the technique of winding. During the eighteenth century the cog and rung gin, that obstructed the pit mouth, was superseded by the whim gin whose mechanism was largely positioned some distance from the landing stage. A further difficulty arose as the collieries were driven deeper, for the greater weight of the rope reduced the winding

speed. To increase the speed Michael Menzies introduced a 'water-pulling machine', and in spite of certain problems it was widely adopted after 1753, with the proprietors of the Basingthorpe Colliery working a variant of the machine around 1760.(16) The Newcomen engine was adapted to assist the raising of corves, whereby pump water was lifted to a trough that fed an over-shot waterwheel that worked the lifting gear. In 1774 John Smeaton installed a similar device at the Griff Colliery, Staffordshire and according to John Curr there were no fewer than 30-40 water coal gins in use in the Newcastle and Sunderland area by 1797.(17) The main advantage of this adaptation lay in the utilisation of existing capital equipment and a reduction in the number of gin boys and horses that otherwise would have had to be employed. However, the Newcomen engine was unable to solve the problem of raising heavy loads more quickly from the deep mines. This had to await the introduction of steam winding engines in the 1780's. Other technical problems associated with unequal axle weights and collisions within the shaft were largely overcome by the flat rope and conductors introduced by John Curr, whose innovations will be dealt with later in more detail.

On reaching the surface the coal was pulled by horse-drawn sledge to the coal stack, but as the quantity of coal reaching the surface increased, this method was seen to be slow and inefficient. The solution came with the introduction of tiplers that emptied the corves into waiting waggons that ran on self-acting inclined planes or hauled by stationary engines to the pit stack or point of disposal.

It can be seen that from primitive small scale collieries the increased scale of exploitation in deeper and more extensive mines raised major technical and logistical problems. The solution of these difficulties led to the rise of highly proficient mine engineers and a capital intensive industry. Our attention must now turn to the Norfolk and Rockingham-Fitzwilliam collieries to see how these proprietors attempted to overcome the problems

associated with large scale mining.

The Norfolk Collieries

Methods of Extracting the Coal

A variant of the longwall method of mining was adopted in the Norfolk collieries with the exception of the Attercliffe Colliery that worked the Barnsley coal seam. The impact on coal output of the longwall method was considerable. For example, an estimate in 1773 on the quantity of coal capable of being extracted in the Manor Colliery stated that of the Manor seam 38 inches thick containing 5111 solid yards per acre, only 51 solid yards was required to be left. At the Hesley Colliery in 1803 only one-tenth of the coal was left for posts, and in 1817 it was assumed that nine-tenths of the coal could be extracted in the Sheffield Park and Handsworth collieries. On visiting the Sheffield Park Colliery in 1796, Hatchett, who was on a tour of England and Scotland visiting mines and manufactories, wrote that the working places were 20 yards or more in length, and the posts supporting the roof were removed as the coal face advanced, leaving the roof to collapse behind. He went on to write that this method was used only when the roof was brittle, otherwise colliers cut 6 to 8 yards of coal before leaving a pillar of coal 8 yards in length.(18)

At this point, although not precisely on the main theme, is probably the best place to refer briefly to the wages and conditions of work of the colliers. The Meadow Pit at the Handsworth Colliery in 1814 contained banks 24 to 52 yards in length, each worked by family groups of 3 to 4 members. There were advantages in employing family groups. They allowed for a greater work discipline, provided a more harmonious work routine and assisted the process of efficient training. It was general for a boy to be employed initially as a gin or trap boy and work his way to become a hurrier, before eventually becoming a hewer who received the highest wage of the manual

workers. The companies were paid at a fixed rate per corf, with an allowance of between 15s and 16s for 'setting' and 'getting' wood. Whereas in other coalfields the leader of a company or butty was left to hire the necessary labour, the practice of employing family groups largely overcame the inconvenience of procuring labour at the Sheffield collieries.(19)

Wage rates varied according to the work and age of the employees in the Norfolk collieries. On reaching the pit head the corves were noted down in a 'motty book' under the company leader. Each had its distinctive motty or peg which was attached to the corf for identification by the banksman. These were 'cast up' and the total of corves divided by six to transfer them into carts. In 1815 at the Handsworth Colliery, the hard coal was calculated at 2s 6d per cart (17.75 cwts) and the small at 1s 3d with allowances regulated according to the 'situation' of the bank. Headings were driven at the rate of 3s and 3s 2d per yard in the level, and boardgates 18 feet wide at 2s per yard. An additional allowance of 1s per score was paid for retrieving punches in the long banks, and 6d per score in the short banks. Horse drivers were paid according to their age at 6s, 7s or 8s per week. In the 'Leversidge Bank' at the Meadow Pit, colliers were paid 2s 3d for cutting post holes and 3d per yard for ripping the top down. Posts were usually 10 yards thick with post holes cut at 10 yard intervals. Each company was paid to extract the coal and carry it to the bottom of the gates with the lessees directly hiring the 'hangers-on' and workers to maintain the gates. By 1815, the companies were responsible for hewing, filling, hurrying, setting the punches and driving the post holes.(20)

At the Sheffield Park Colliery in the 1780's, the pits were named after the company leader but by 1789 this practice had been abandoned with pits being referred to by number, and each employing two companies.(21) As the company leader was paid a lump sum it is not possible to calculate the wage per worker. In the East Midlands Coalfield:

'The butties (usually two in partnership) engaged holers by the stint, hammerers, loaders and banksmen by the ton and children by the day'.(22)

This was not unlike the method of payment in the Sheffield collieries where hewers were paid by the waggon, corf or ton, heading by the yard, topsmen, jinney boys, trap boys and driving by the day, and hurrying by the waggon. Higher rates were paid for driving headings and roadways which had to be driven parallel to the main cleat. The Sheffield Park Colliery hired separate companies to drive the headings with wage rates varying in relation to the direction, height, width and difficulty encountered.(23)

To return now to the major theme; the extraction of coal from the pits. The main tools of a collier consisted of a pick, shovel, hammer and wedges. The first operation in working the coal was to undercut or hole the face at the bottom to a depth of 2 feet 6 inches to 3 feet 6 inches with a pick, although vertical grooves were sometimes made. It was during this stage that a considerable quantity of slack was produced that could only be used in the Newcomen engine. The coal was brought down in large pieces by wedges hammered into the coal face. In the Orrell coalfield the wedge measured 12 inches long, 2½ inches wide and 1 inch thick in the middle, tapering to one end with the striking end octagonal in shape. Shortly before the opening of the Attercliffe Colliery, records show a payment for 5000 wedges at 1d per score.(24)

The expansion of the Norfolk collieries led to a greater division of labour, which in turn contributed towards increased efficiency and output. Hewers brought down the coal for fillers to load the corves that were hurried to the shaft bottom by boys leading horses. Hangers-on fastened the corf to the winding rope to be wound up the shaft by a gin boy supervising the horse drawn whim gin and later by engine 'tenters'. Trap boys worked the ventilation doors, 'wood getters' cut the punchwood and masons lined the shafts,

horsegates and soughs. Other workers drove the headings, banksmen supervised the surface including the coal stackers, carpenters, blacksmiths, fire-pan and engine 'tenters'.

It is not possible to calculate accurately the number employed in the Norfolk collieries as the employees were not individually itemised prior to 1820. Pollard has stated that not more than 200 men were employed in 1790. Even so, this was a considerable increase over the 15 coal 'getters' with their usual assistants allowed John Bowden in 1737, and by 1820 the Sheffield and Handsworth collieries employed some 281 workmen, with six at the Farm.(25)

Drainage

The Norfolk collieries were drained by soughs and pumping engines. A report on the collieries in 1773 referred to the Sheffield Park Colliery sough that ran for 1½ miles to the River Sheaf whilst the Manor Colliery sough extended for some 2 miles by 1785. To prevent roof falls, they were lined with brick and timber. The need to sink deeper collieries, brought about by the increased demand for coal and the exhaustion of the shallower deposits, stimulated the development and adoption of atmospheric and steam pumping engines although their introduction involved a considerable capital expenditure for the colliery proprietor. In 1797 John Curr estimated that an outlay of £2004 was needed to purchase a 'fire engine' with a 50 inch diameter cylinder along with the construction of an engine pit. The high cost of colliery drainage can be seen in 1787 when John Buddle, senior, reporting on the Sheffield and Attercliffe collieries, estimated that to drain 315 acres of coal in a new colliery at Crooks Croft would cost £5000. This figure included the purchase and erection of a 'fire engine' and sinking the engine pit to a depth of 52 yards. Pumping engines were at work in both the Ponds and Attercliffe collieries in 1789 and by 1800 some five engines were in use at the latter mine. In 1805 the 'Main Fire Engine' on

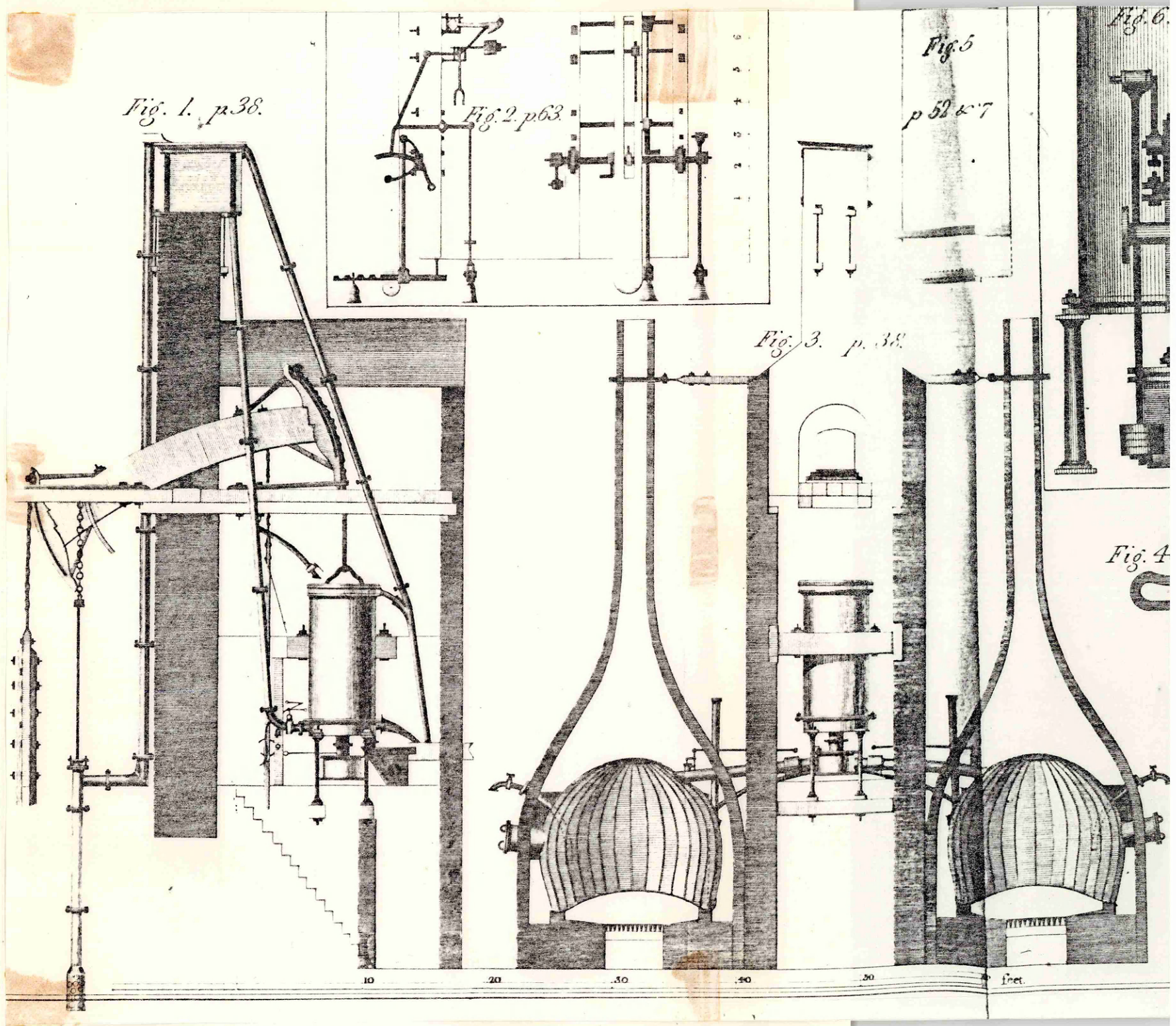


Fig. VII. THE ATMOSPHERIC PUMPING ENGINE.

curr, op. cit., Plate 4 facing page 44

Attercliffe Common had a cylinder of 61 inches in diameter, with a 50 inch cylinder at Crooks Croft and another of 40 inches at the Ponds, costing approximately £1556-0-0, £1146-0-0 and £825-0-0 respectively.(26)

John Curr not only supplied engine parts from the foundry, he established in 1792, but became a skilled engine builder and engineer, improving the Newcomen engine's performance and adopting it to other colliery uses. He found that a better vacuum could be produced when the cistern was placed about 36 inches above the top of the cylinder, compared with the usual 12-14 inches. The additional height of the cistern gave a more rapid condensation and better vacuum and so '... obtained a considerable addition of power, without any increase of fuel.'(27) This was his major contribution to the improvement of the Newcomen engine although he furthered the adoption of valves, due to their greater reliability and ease of repair, compared with the 'common regulator and injection cock.'(28)

The introduction of 'fire' engines did not eliminate the problems associated with drainage as the inflow of water could still involve the proprietor in additional major capital expenditure or the temporary abandoning of the workings. For example, at the Lumley Colliery, belonging to the Earl of Scarbrough in County Durham:

> '... in March 1780 the engine began to fail in its constant battle against water. Horses were brought in to give extra power, pitmen were made idle and it was admitted that the present engine was too small and a 50 inch cylinder was essential.'

A second pumping engine was recommended which involved a further expenditure of £1200.(29) The Attercliffe Colliery also had serious drainage difficulties. that necessitated the installation of five pumping engines by 1800, with running costs in that year of £3,000. It was drainage costs such as these that were a major factor in persuading landowners, such as the 11th Duke of Norfolk, to revert to the role of colliery lessors.(29a)

Ventilation and Lighting

A colliery report on the Norfolk collieries in 1773 referred to 'fire-lamps' burning coal and level drifts for air and water, that would suggest a movement of air was obtained by fire, although atmospheric pressure could have been used by taking advantage of the hill in Sheffield Park. The Attercliffe Colliery was ventilated by a fire-pan with the air coursed around the workings by trap doors. This method was probably introduced into the Sheffield Park Colliery in 1783 when the accounts show, for the first time in December, payments for trap door 'tenters'. In the Sheffield Park Colliery only four trap boys were employed, for under the 'longway' method of working, less of the old workings needed to be ventilated in comparison to the pillar and stall system. Curr devised an automatic device for opening and closing the underground ventilation doors, although no evidence has been found that it was ever introduced into the collieries. The device may not have been practical in a wet and dusty environment where it was liable to heavy usage, whilst the abundance of cheap child labour may have made it uneconomic to install and maintain.(30)

On visiting the Sheffield Park Colliery, Hatchett commented that:

'Air shafts are sunk every ½ mile nearby and two are worked at a time, a fire being made at the bottom of one to keep up a current of air.'

Even so, not all the workings were properly ventilated, and this must have posed a threat to the safety of the colliers:

'Near the Working Place was a continuation of a passage into which we were cautioned not to go with candles as the fire Damp was there for want of a proper circulation.'(31)

The Norfolk collieries appear to have had few casualties as a result of gas explosions according to the number of payments made for the treatment of colliers as recorded in the accounts, although it is possible that minor accidents were not thought sufficiently important to be noted. A payment

of £4-5-0 to W.G. Frith on 26 June 1805 for medicines and care of the workmen injured by firedamp in the pit would suggest that treatment was provided free by the management.(32) Many of these accidents would have been as a result of using the candles and oil lamps that up to 1805 were provided free by the proprietor.

Underground Haulage and Winding

If the Norfolk collieries were to be worked on a more extensive scale then a more efficient method of moving the coal from the working face to the pit top had to be introduced, to prevent congestion at certain parts of the mines. It was not until the collieries were taken under direct management that the necessary capital equipment was introduced. But capital was not the only ingredient vital to an efficient capital intensive enterprise, it also required the engineering expertise of John Curr as superintendent of the collieries.

During the 1770's, coal was carried underground in the Sheffield Park Colliery in hazel wickerwork kibbles, that held approximately 10 pecks, which were fixed to sledge-trams.(33) The proprietors, Townsend and Furniss, seemed unaware that a larger corf would have increased their efficiency, for a report in 1773 suggested they substituted a 16 peck corf in order to draw a greater quantity of coal. There may have been some reluctance on the part of the proprietors as the raising of the larger corf required the installation of another whim gin. The relative backwardness of the Sheffield Park Colliery can be seen in the use of basket or hazel corves as late as 1781.

One of the outstanding figures in waggon-way and corf innovation and someone whose work needs to be considered at length, was John Curr, superintendent of the Norfolk collieries. One of the most important innovations was the substitution of the baskets, in which the coal was carried, for four-

Fig. 1. Page 15.

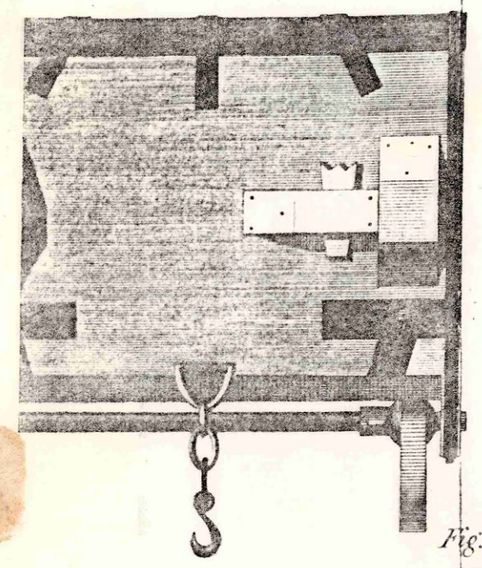


Fig. 4. P. 20.

Fig. 3. P. 16.

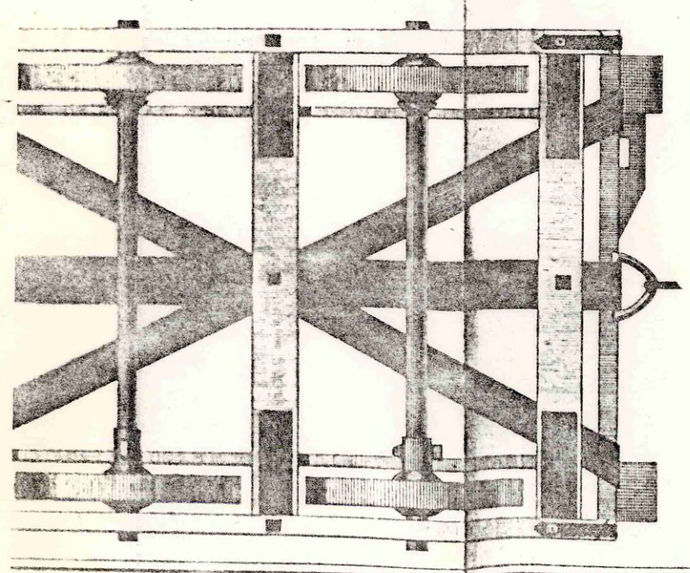


Fig. 2. P. 15.

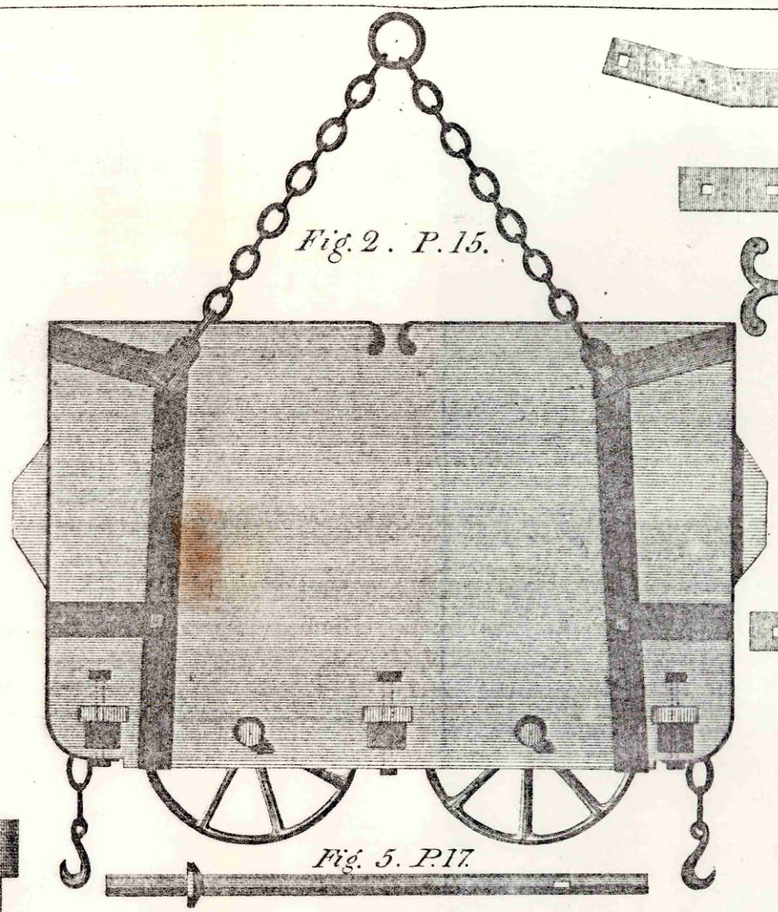


Fig. 5. P. 17.

Fig. 6. P. 20.

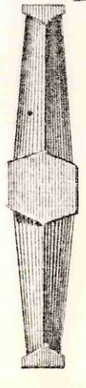


Fig. 7. P. 17.

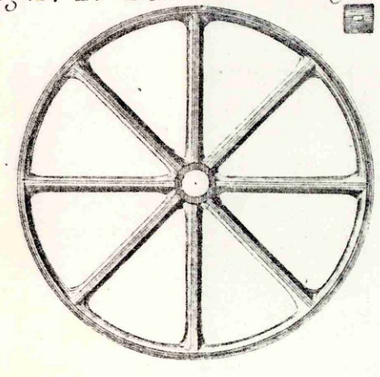


Fig. 8. P. 18.

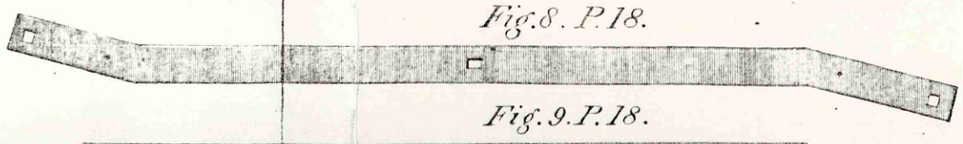


Fig. 9. P. 18.

Fig. 10. P. 18.

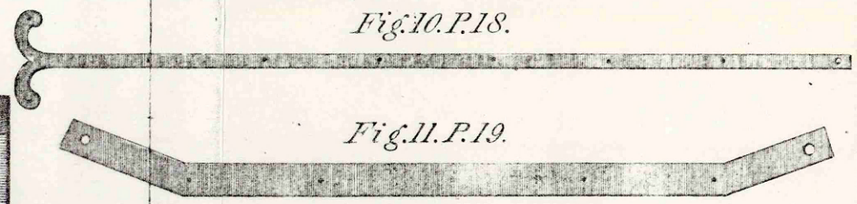


Fig. 11. P. 19.

Fig. 12. P. 19.

Fig. 13. P. 19.

Fig. 14. P. 19.

Fig. 15. P. 21.

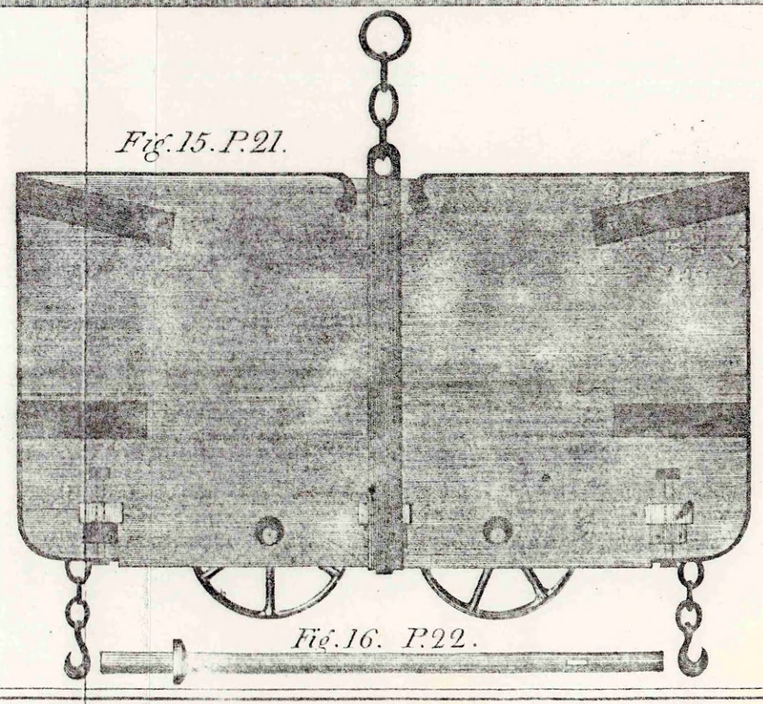


Fig. 16. P. 22.

Engraved by The Harris, Sheffield.

Fig. VIII.

FOUR WHEELED CORVES.

Corr, op. cit., Plate I Facing page 22.

wheeled corves.(34) Curr replaced the old kibbles, used by the previous lessees, by solid board and iron corves and advocated the use of two corf sizes depending on whether the 'longway' or 'short work' method of working the coal was in operation. Corves became a major item of capital, involving an expenditure of £2-16-6 or £2-13-6 each, depending on size. This type of corf remained much the same except by 1820 the Flat Pasture Pit could boast 13 iron corves which at 61s each were more expensive than the wood and iron corves. Curr did make an improvement to the corf design in 1799, which produced a saving on horses, grease and labour of £200 per annum, according to the inventor.(35)

It is not clear when horses were introduced underground, but there was an immediate expenditure on horses when the collieries were taken 'in hand' in 1781. Waggon-ways were constructed below ground in 1783 with the first payment to boys leading horse drawn corves in January 1784. It was commonplace to employ boys in the Norfolk collieries during the 1780's as hurriers or trappers underground and as 'jinny' boys on the surface.

Cast iron plates to surface the beech rails had not been introduced prior to November 1785, although there would have been ample opportunity to have done so as new waggon-ways were being installed at this time. It was not until shortly before April 1787 that John Curr introduced into the collieries a new system of hurrying using cast iron plates. John Buddle a mine consultant who was hired to inspect the collieries and report on Curr's innovations, calculated that the new method of hurrying saved 3¾d per waggon or £321-10-0 per annum. This marked the introduction of the underground four-wheeled corf, which according to Buddle, gave the additional advantage of being easier to handle by the banksman. Although wheeled corves were already in use in the Newcastle area, the novelty of Curr's method lay in the whole corf and tram being hauled up the shaft instead of the corves

Fig. 1. p. 24.

Fig. 2. p. 25.

Fig. 3. p. 25.

Fig. 4. p. 27.

Fig. 6. P. 28.

Fig. 7. p. 25.

Fig. 8. P. 23.

Fig. 5. p. 27.

Fig. 10. p. 24

Fig. 9. p. 23.

Fig. 15. p. 29.

Fig. 14. p. 28

Fig. 12 p. 26.

Fig. 11. p. 27.

Fig. 13. P. 27

Engraved by Wm. Harris, S

Fig. IX. CAST IRON RAIL ROAD PLATES.

having to be emptied into baskets before being wound to the surface. The elimination of the second handling enabled a greater quantity of coal to be raised during the working day, and so reduced the cost of production. The efficiency of the new method can be seen in June 1796 when the Sheffield Park Colliery employed only nine horses to 'hurry' 150 tons of coal a day, although they were capable of raising 200 tons per day, compared with the Heaton Colliery near Newcastle that had to work 80-100 horses to move 600 tons of coal per day. According to Curr, a horse could pull between nine and ten corves on the nearly level waggonways of the Sheffield collieries compared with only two or three corves of similar size in the Newcastle and Sunderland mines.(36) Soon after 1787 Curr replaced the 'plateways' by cast iron railroads. The adoption of these waggon-ways was encouraged by the technical advances made in the iron industry that produced cheaper cast iron and so increased its competitiveness to wood. Curr was not the originator of cast iron rails for the Darbys of Coalbrookdale had produced some as early as 1767, but he may have been the first to have used them underground.(37) The cast iron rails introduced by Curr had flanges to keep the trams on the rails and '... in that respect were less in line with later developments than were those at Coalbrookdale which were designed for flanged wheels.'(38) However, they did overcome the immediate problem concerned with increasing the movement of coal from the coal face to the shaft bottom, and so contributed towards increased production.(39)

In the Sheffield Park Colliery the permanent gates or roadways, along which the corves were hauled, stood between 5½ to 6 feet in height, were lined with stone and extended for 1¼ miles from the shaft bottom by 1796. The increased depth of working coal in the Norfolk collieries meant that the shafts and the roadways became permanent, since these were more expensive to sink and construct respectively.

It was expected that colliery managers should be able to solve the everyday working problems and also assist in reducing production costs. In Curr, the Norfolks had a superintendent of considerable ability, who was able to make major contributions to mine engineering. He was constantly attempting to raise output and lower costs, which can be seen even in his minor innovations. An indication of this was the introduction of a brass bush into the corf wheel in which the axle ran. This prevented the disposal of the whole wheel when the axle hole became worn, for now it needed only the insertion of another brass brush. The innovation not only reduced the purchases of corf wheel replacements but made '... the corf easier in its draught, and consume less grease than iron workg. to Iron.'(40)

On a visit to the Sheffield Park Colliery in 1796 Hatchett commented on the underground haulage of coal, where the loaded corves were brought some 1¼ to 1½ miles by horse along iron roads from the working place to the shaft. The horse was led by a boy for a distance of 250 yards. At this point the full corves were exchanged for empty ones. The corf:

> '... when loaded contains between 5 and 6 cwts of coals yet by Mr. Curr's invention of iron rails by the rollers or wheels of the corves and by the passages being nearly perfectly level, one Horse is able to draw without difficulty from 12 to 14 loaded corves at a time, whereas before the Iron rail roads were used only two corves could be drawn at once.'(41)

In 1797, Curr wrote, that in the Norfolk collieries the corves were deposited on the nearly level main roads in four or five different parts of the works until 11 to 14 had been collected, which were then hauled to the shaft. Each corf contained 19 pecks 'Newcastle measure' of about 5½ cwt with a horse carrying for a 'moderate' days work 150 tons a distance of 220 yards. The horses usually pulled 12 corves, although they were capable of hauling double this number where the ground fell ½ inch in the yard.'(42)

During the last twenty years of the eighteenth century the Norfolk collieries were in the forefront of haulage innovation. Their improvements were adopted in many other coalfields. Trinder, for example, noted that Curr advised the Coalbrookdale partners in the early 1790's.(43) Curr's innovations greatly increased the efficiency and level of output in collieries and reduced the number of hurriers and horses employed, to produce a saving on wages and fodder. The reduction in the cost of haulage was important during a period when costs generally were rising.(44)

Even more ambitious plans in the haulage of coal were proposed by Curr in a scheme for the working of a new colliery at Crooks Croft. The scheme involved the coal being carried by canal from the workings to the surface, as in the Duke of Bridgewater's colliery at Worsley. There was, however, an important modification on the Worsley system, for Curr planned that the corves should be lifted directly into the barges without having to be unloaded. It was probably to acquire first hand knowledge of the system at Worsley that Curr made a visit to the Duke of Bridgewater early in 1787. John Buddle who studied Curr's plan thought it was the most favourable mode of haulage for the proposed Crooks Croft Colliery. Furthermore, it would save the expense of drawing coal from a depth of 150 yards, the charge of leading from the pits to the coal stage, the cost of a waggon-way and at the same time, it would overcome the problem of drawing the water that seeped in with the use of shafts. Curr devised hoists to raise the corves into the barges, a subject on which he was sufficiently knowledgeable for his advice to be sought by the Coalbrookdale Company. The average annual savings over 27 years of the navigation scheme and associated improvements was calculated by Buddle at £1852, but even so no evidence has been found to suggest the scheme was ever adopted.(45)

The improvements made in the transportation of coal from the coal face to the shaft bottom would have been to no avail without advances in winding

the coal to the surface. The greatly increased quantities of coal reaching the shaft bottom had to be wound more quickly to the surface to prevent a bottleneck at this stage in transporting the coal. During the 1780's the whim gin was used to raise the coal in the Norfolk collieries. In addition, Curr used the Newcomen pumping engines to work water-wheels that operated the lifting gear. Such machines worked at the Attercliffe and Sheffield Park collieries, where during the summer months the 'fire engines' had been so constructed as to be able to raise water to the top of the water-wheel, but during the winter a brook was used as the engine was fully utilised to drain the workings.

The introduction of the Boulton and Watt steam winding engine into the coalfields from 1786 enabled heavy loads to be raised from greater depths and replaced the horse in winding. John Curr appreciated the engine's value, and the Norfolk collieries were sufficiently extensive for it to be introduced. So convinced was Curr of the potential market for steam engines that he established his own foundry in 1792 to supply iron castings, rails, and engines, with cylinders ranging from 14 to 32 inches. By 1796 the Sheffield Park Colliery had four steam winding engines drawing coals with a further two at the Attercliffe Colliery, whilst the Hesley Colliery, valued by William Dunn on 23 November 1803, had a machine for drawing coals assessed at £250. Although in 1797 Curr thought that it was '... extraordinary, that the drawing by machines has not yet made greater progress in the southern parts of this Kingdom,' they did represent a major capital investment that many of the smaller colliery proprietors could not afford. In addition, skilled engineers were needed to repair and maintain the engines, unlike the whim gin, that was relatively easy to repair and cheap to purchase. Even the Norfolk collieries still used whim gins as late as 1820.(46)

The greater depth of collieries and the angular shape of corves increased the possibility of collision within the shafts. In the Norfolk

collieries Curr overcame this problem by the installation of conductors. Two pairs of deal rails measuring 4 x 3 inches were installed in the shaft with the corf suspended on a crossbar that ran with the aid of rollers in a channel formed by the guide rods or conductors. At the point where the corves passed each other, the risk of collision was further reduced by dividing the shaft into two sections. They greatly increased the rate at which the coal could be drawn to the surface, for not only was the speed of the corf raised to 840 feet per minute but two could be hauled up at the same time. A further advantage of the system was the increased working life of the corves as they were no longer susceptible to collision and damage in the shaft. The success of this innovation was seen in its widespread adoption in the South Yorkshire coalfield. Indeed, many other coalfields were to install the system, although its use was limited in the deeper collieries of the Newcastle area where the Walker and Walls End pits had respectively reached depths of 430 feet and 630 feet by 1787.(47)

In conjunction with conductors Curr devised a system of emptying the corves on reaching the pit top by the use of a tipler. This worked as follows. When the corves reached the pit top, a platform was slid over the mouth of the pit shaft. At this point the corves were pushed forward by two empty ones which were the next to go down the pit shaft. By this process the full corves were rolled to the edge of a platform where a discharging machine (the tipler) emptied the contents into waiting carts. Six months before his dismissal in 1801 Curr proposed raising the Bank at the Sheffield Coal Yard for the easier 'delivery and preserving of Hard Coal', to save £120 per annum.(48)

On examination of Curr's innovations, John Buddle reported that his conductors, the method of landing the carriage and the device for throwing the rope out of the way of the carriage on which to land the corves were

'... founded on true mechanical Principles.' The method used to raise the corf along conductors and the system for landing the corf were installed in all the Norfolk collieries, and their widespread adoption in other mining areas allowed Curr to receive '... something handsome for the Patent Rights from sundry Proprietors of Collieries.'(49)

The increased depth of collieries and weight of the corves posed serious problems in the use of winding ropes, and it was in this area that Curr was able to make major advances. In this connection he invented the 'double rope' which produced considerable savings since it was able to draw more than double the quantity of coal to the surface.(50) The problem associated with counterbalancing the rope remained, for as the opposing corves reached the bottom and top of the shaft respectively, their pulls on the axle was unequal due to the difference in weight of the two ropes and the corves. The solution, put forward by Curr in 1798, was the flat rope, which entailed the stitching together of several circular ropes. For this Curr invented the 'Flat Rope Lacing Machine' and set up his own business for their manufacture. It was generally adopted throughout the coal industry with the inventor claiming that the:

> '... Invention of the Flat Rope (3 years ago) has drawn in one instance 5 times as much as the com^{n}. Round Rope, in another instance 3½ times, and in others 3 and 4 times as much, but the Ropes now in use, being more perfectly manufactured will do 6 or 7 times as much work as the Common Ropes, and thereby save 3 or 4 hundred pounds, per annum in the Duke's Collieries.'(51)

Surface Haulage

Before the introduction of waggon-ways coal was moved from the collieries into Sheffield by cart, the supply of which must have been interrupted during the winter months, and as only small quantities could be moved at a time, the cost of transport was high. The considerable cost of carrying

coal by cart can be seen in 1793 when William Dunn calculated, that to extract one ton of small and 'Great Coal' at the Dore House Colliery, Sheffield, would cost respectively 1s 8d and 4s 2d, but the carriage into Sheffield would add a further 4s 2d.(52)

The lower costs of transport associated with waggonways persuaded the Duke of Norfolk in 1773 to construct a line from the Sheffield Park Colliery to the coal stage in Sheffield, a distance of $1\frac{3}{4}$ miles. A further inducement came from the severe competition by a colliery on Attercliffe Common, worked by Oborne, Smith and Clay. Lying adjacent to the turnpike road into Sheffield the proprietors of the Attercliffe Colliery had no road repairs unlike the mine in the Park that had to maintain the roads over which its coal was carried. A report on the Sheffield Park Colliery in 1773 laid emphasis on the need to construct a waggon-way to provide a regular supply of coal to the stage.(53) During the winter months the supply of coal into Sheffield would have been interrupted by adverse road conditions that would have lowered the profits of the colliery. It was estimated that to carry coal on the waggon-way would cost 1s per load in comparison to 2s 6d per load to lead coal by road.

The waggon-way was to be constructed at an estimated cost of £2000 of oak and beech, on which waggons with metal wheels were to run. The money for the project was probably advanced by the Sheffield estate and repaid by a reduction on their royalty.(54) The waggon-way was completed shortly before Christmas 1774 at a cost of £3,280. It had an immediate effect of enabling the proprietors to reduce their coal prices, as it allowed the coal to be sold at the Sheffield coal stage at 3s 5d per load (17.75 cwt) instead of the previous 4s 11d per load.(55) However, the inhabitants of the town fearing an increase in coal prices tore up the waggon-way, but it was later relaid in cast iron on stone sleepers. The construction of the waggon-way increased the competitiveness of the Sheffield Park Colliery as it reduced

the price of coal at the coal stage and eliminated the need to repair the roads through the Park, following the damage done by the coal leaders' carts. Norfolk was able to take advantage of their lower transport costs by raising the colliery rent.

After Curr became superintendent of the Norfolk collieries he installed on the surface inclined planes, where the gradient exceeded 3 inches to the yard, whereby full corves descending by their own weight and velocity hauled up empty corves to which they were attached. Such waggon-ways were constructed to move coal from the pit head to the coal hill, with a distance of 300 yards found to be the most practical. This enabled the colliery proprietor both to reduce the number of horses employed and the cost of hurrying the coal above and below ground. In 1805, for example, there were only 38 draught animals employed at the Norfolk collieries.(56)

At this point we might summarise, using the work of John Curr as the major illustrative thread in the history of the Norfolk collieries. On taking the Norfolk collieries into direct estate management Curr was faced with major geological difficulties that had contributed towards the financial crisis of 1781. Not only had Curr to overcome the adverse geological conditions but those problems associated with mining on a large scale. These included the necessity to move larger quantities of coal more rapidly from the coal face to the pit hill. The solution called for a considerable degree of ingenuity and engineering expertise from the colliery superintendent. Without the introduction of Curr's technological innovations the Norfolk collieries could not have been exploited on such a large scale nor have met the rapid rise in demand for coal from the Sheffield manufacturers. This is not to say that all the engineering problems were solved, for apart from the introduction of longwall mining no major improvements were made in hewing the coal, whilst drainage and ventilation remained a perennial cause for concern. It was in the areas of haulage and winding, both underground

and on the surface, that Curr made the most important contribution to mine engineering.

Technological Innovations in the Rockingham-Fitzwilliam Collieries

The distance from the Don Navigation limited the exploitation of the mineral resources on the Wentworth estate, a situation that was to continue until the completion in 1805 of the Dearne and Dove Canal with its branch into the Elsecar valley. Many of the Fitzwilliam collieries were typical of those on other inland coalfields that were located away from an extensive market or low cost canal transport.(57) As a consequence, the low output and profits of the Elsecar, Lowwood and Westwood collieries did not justify a large capital expenditure on drainage and haulage. In comparison, the collieries close to the Don Navigation leased to Bowden and the Fentons enjoyed a wider coal market, and were able to extend their scale of mining and introduce high cost capital equipment.

At this point it is convenient to say a little more about the Basingthorpe Colliery worked by William and Thomas Fenton, under lease from the Wentworth estate. This concern will be used as a yardstick by which to compare the other Rockingham-Fitzwilliam collieries prior to 1795. The completion of the Don Navigation from Fishlake to Tinsley in 1751 appears to have encouraged the Fentons to open the Basingthorpe Colliery in 1758. After the withdrawal of Bowden from the Carr House Colliery in 1764 the Basingthorpe Colliery became one of the largest in the area until they withdrew soon after their lease expired in 1818. In the 1760's the Fentons worked at least one Newcomen engine and constructed a waggon-way to the Don Navigation; with a recorded length in 1771 of 2 miles. The cost of transport was further reduced in 1781 after Rockingham constructed the Greasbrough Canal from the Colliery to the Don Navigation. Little evidence remains that records in any detail the development of the Basingthorpe Colliery although a bill head for

Fig. X. THE BASINGTHORPE / GREASBROUGH COLLIERY 1820. W.W.M. SC. P.13(a) 87, S.C.L.

1820 shows a steam pump and winding engine with a horse-driven waggon-way to the Greasbrough Canal, where Keel boats waited to be loaded. Some indication of the level of capital equipment can be ascertained from the dead stock valuation at the Colliery of £22,930 in January 1809.(58) Now to return to the main theme, the development of the collieries under direct Rockingham-Fitzwilliam management.

Pit Sinking

The shallow workings of many inland collieries meant it was generally cheaper to sink new shafts rather than to extend the headings. This was true also of the Rockingham-Fitzwilliam collieries prior to 1795, for afterwards the deeper and more extensive workings reduced the frequency of sinking new pits. During the 1780s the Elsecar Old Colliery sank on average three pits every two years, but the greater depth of the Lowwood Colliery reduced this to two pits every seven years. The relative low cost of sinking a new pit is seen in 1752 when Thomas Hoyland and George Smith were paid £3-18-0 for a pit 15 yards 1 foot deep at 5s per yard. Even by 1778 John Speaight was paid 10s 6d per yard to sink a pit only 33½ yards deep. In comparison the Lowwood Colliery had to expend £200 for a deep pit and £120 on a bassett pit.(59)

Although it was common practice, according to Ashton and Sykes, for small collieries to hire companies to make borings, this was not so on the Wentworth estate. They carried out their own boring and sinking of shafts and only occasionally hired outside contractors. Before a pit was sunk, preliminary borings were made to ascertain the depth and extent of the coal and the presence of any faults. A group of sinkers was then employed to sink the shaft at various rates per yard depending on the depth, difficulty of working, and existence of gas and water. At the making of the bargain a down payment or 'earnest' money was usually given accompanied by ale. An

agreement made in April 1822 to sink pits on the Wentworth estate provides an example of bargains made with their workers. The company was hired to sink an engine and bye pit in Rawmarsh. The engine pit was to be sunk to a depth of 71 yards to the bottom of the '9 feet coal' with a diameter of 9 feet where it was not 'walled' but otherwise it was to be 10½ feet across. The initial 20 yards were to be sunk at £1-0-0 per yard, the next 20 yards at 2 gs per yard with the remainder at 5 gs per yard. As the sinkers were estate employees, this would explain the proprietor supplying the headgear, horses, drivers, and tools, for the agreement was only for labour. In addition they were allowed 14 yards of flannel each, to make two suits, and the work was to be undertaken in three shifts of 8 hours each.(60) Gunpowder was used in driving through hard rock, and fresh air was pumped into the workings by air pipes. Special care was taken not only to site any pit out of view from Wentworth Park but the spoil from the shaft was to be so disposed as not to scar the estate. For example, on hearing of the intention of the Fentons to sink an air pit at the Basingthorpe Colliery, Fitzwilliam ordered that a pond be drained near Lady Rockingham Wood to take the waste.(61)

Where the dip of the coal and its close proximity to the surface allowed, drifts were driven into the workings, as these were less costly than pit shafts. In 1798 it was proposed that a drift be sunk at the Elsecar Old Colliery to extract the coal previously left on the west side of a fault. An oval shaft 9 feet by 7 feet was also sunk to meet the bottom of the drift.(62) Another drift or 'footrill' was sunk in the 1820s on Forge Lane that led into the workings, and it was from such entrances that guests of the Earl were escorted into the mine. Until well into the nineteenth century the Wentworth estate collieries had the advantage of working at shallow depths, but the cost of pit sinking rose dramatically with the exploitation of the deeper coal in the Rawmarsh-Greasbrough area.

Method of Working the Coal

A variant of the pillar and stall method had been adopted in the Rockingham-Fitzwilliam collieries prior to 1793. It was thought that the longwall system of working was unsuitable for the Barnsley seam, where the roof was not sufficiently hard. A plan made by William Fairbanks of the Elsecar Colliery in 1757 shows a deep level driven into the lowest part of the mine from where a sough emptied the drainage water into the nearby Harley Brook. The coal was extracted from the deep up towards the bassett level, with pits located on both levels for ventilation and haulage of the coal.(63)

In 1793 Joshua Biram produced a detailed plan and drawing of the Elsecar Colliery. The deep level measured 2 yards wide by 5 feet high with a counter level lying parallel to act as a filter, to prevent a blockage of the water course. There was considerable room for working, with the banks 9 yard wide and 7½ feet high but to enable the banks to be used as roadways two rows of props were needed to support the roof, to leave a passage 6 feet wide. Post holes were driven diagonally along a line towards the shaft to aid the movement of corves and air for ventilation. The usual square pillars that were common at the beginning of the century had by this time given way to ribs of coal 3 feet thick and between 25 and 100 yards in length. The ribs were widened at the end where they met the 'endways', and later removed as the roadways were abandoned.(64) The longways method increased the proportion of coal able to be worked from the usual 50 per cent to approximately 70 per cent, but this was still far from the 90 per cent or more that could be extracted under the longwall system. At the Elsecar New Colliery from September 1795 - 15 July 1802 some 23.65741 acres produced 69408 dozens (145756.8 tons) of coal but the ribs of coal left between the level, counter level and the banks of 7.99467 acres reduced the workable coal to 15.66274 acres or 66.2 per cent of the total.

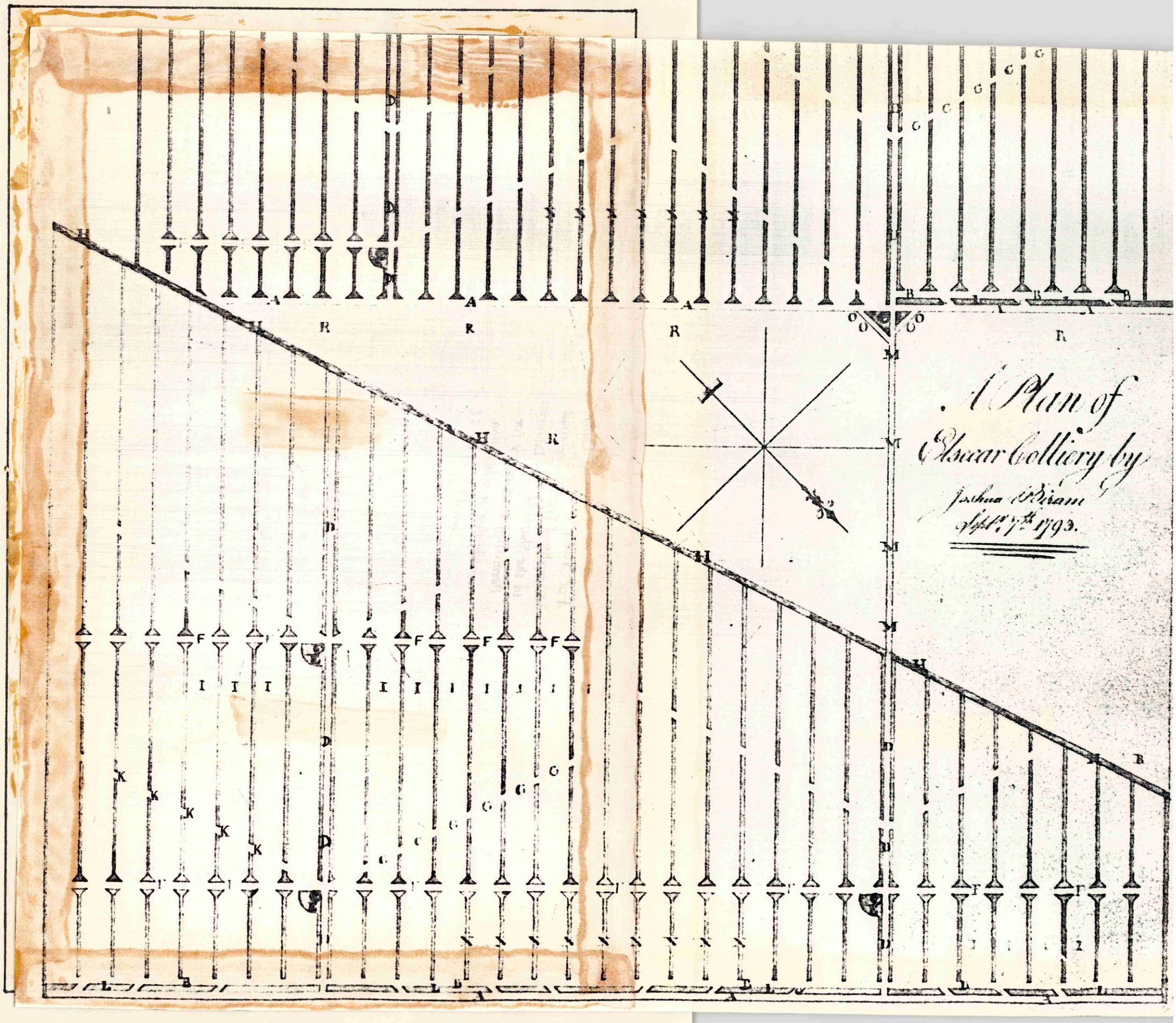


Fig. XI. LONG PILLAR MODE OF WORKING.

W.W.M. MP 56 S.C.L.

	REFERENCE
AAA	The Levels or Water Courses, two Yards wide, and five feet high is on the deep Side of the Colliery and the lowest Part of the Coal Bed that can be drained by the Sough.
BBB	Counter Levels or Counter Headings, two Yards wide and 7½ feet high, made to prevent the Levels or Water Courses from being filled with Sludge, and also to turn the Banks out from.
CCC	Bolt Holes through the Rib of Coal between the Levels and Counter Levels, for the Conveyance of Air into the different Parts of the Works.
DDD	Board Gates are two Yards wide and 7½ feet high [the height of the Bed of Coal got] their Directions are at Right Angles with the Levels or Water Courses, from which they rise and are continued to the Basset of the Colliery.
EEE	Cheek Posts are Pieces of solid Coal left at the Sides of the Bottom of the Pits to support the Pits or Shafts.
FFF	Endways or Cross Gates are two Yards wide made at Right Angles from the Board Gates or Broadway of the Coal and parallel to the Levels and Counter Levels, which Endways always lead to the Pit Bottoms, and are for the use of turning Banks from, to the deep and basset Sides of and for hurrying the Coals from the Banks to the Pits.
GGG	Cross Gates half End and half Board being a Diagonal across the Banks through the Posts or Ribs of Coal left for a support to the Roof, made for the convenience of bringing the Coals in an easier manner to the Pit Bottom.

HHH	A Throw of about two Yards in Breadth or Thickness, at which Place the Bed of the Coal ends; yet when that Throw of two Yards is got through, the Measures, Materials or Strata, are found to be those above the Bed of Coal, and the Coal Bed at this Throw is thrown down ten Yards, and in order to recover the Bed of Coal on the other side of the Throw, the Level was begun down in the old Board Gate, so as to gain one Yard of Level in the old Board Gate before it passes through the Throw, from which Throw the Level or Sough being continued about one Hundred Yards, recovered the Coal so far, as to sink a Pit and begin getting Coals, yet it required about nine Yards more to recover the Foot of the Bed.
III	Banks nine Yards wide, from which the Coals are got 7½ feet in height or Thickness, the Roofs of which Banks are supported by two Rows of Punches 7½ feet long and two feet asunder on each side a Road of six Feet in the middle of the Banks for the Coals to be drawn in Corves by one Horse to the Pit.
KKK	Post Holes, made through the Posts or Ribs of Coal that are left between the Banks for the support of the Roof, which Post Holes are for the Coals to be drawn in a ready manner to the Pit Bottom there are Post Holes struck frequently for the Conveyance of Air, when it is not necessary for a Cross Gate to pass through them.
LLL	Ribs of Coal two Yards thick between the Level & Counter Level to secure the Water Courses.
MMM	Sough five feet high and three feet nine inches wide, being one Hundred Yards in Length from the old Works, through the Throw and the several measures or strata to recover the Coal Bed.

NNN	Posts or Ribs of Coal, between the Banks, three feet thick to support the Roof, the Ends of which Posts are left Strong, by the Banks being wrought strait, when turned out of the End-way or Counter Level, and are to strengthen the Support for the Endway, which strong Ends may be got, when it is no longer necessary to use the Endway or Counter Level.
OOO	Two Flackets wrought half End and half Board to convey the Water from the Level into the Sough without coming into the Pit Bottom.
PPP	Pits Bottoms or Bases of the Shafts for drawing Coals being Eight feet Diameter.
QQQ	Banks eight Yards wide (the Roof being more Tender) from which the Coals are got on the South West Side of the Throw.
RRR	The Bed of Coal below the new Level on the South West Side of the Throw.
SSS	Old Works where Coal has been formerly got.

W.W.M. MP56 S.C.L.

A far greater proportion of coal could be extracted at the Westwood Colliery that worked the Parkgate seam under the longwall system. A water course 1 yard wide assisted both drainage and ventilation, whilst a boardgate was driven from the deep level to the shaft and then forward to the banks. The boardgate was supported by 'posts' 1 yard thick through which holes were cut. As the boardgates were abandoned the posts were removed, providing dangerous work for the colliers from the constant threat of roof falls. Along the bank face two rows of punches were positioned to support the roof with the back row being moved forward as the face advanced. The roof then settled on long pillars constructed of waste with the ironstone located immediately above the coal being allowed to fall down between the packs to be gathered daily. As the coal face was some 60 yards in length the colliers could work in companies, which enabled a greater division of labour compared with the one or two hewers per bank in the Elsecar and Lowwood collieries.(65)

The proposed plan of working the Elsecar New Colliery differed little from that of the Elsecar Old Colliery. A Newcomen engine was installed to raise water from a level that ran for a mile towards Coley Lane. The Elsecar Ironworks of Darwin and Co. was supplied directly from the colliery by a boardgate 100 yards in length to their shaft. The Barnsley seam was to be worked in 10 yard wide banks separated by posts 2 yards in width in blocks of coal 400 yards long. However, the brittleness of the roof only permitted the banks to be 8 yards wide with posts one yard thick. This reduced the proportion of workable coal, for in comparison, the nearby Cortworth Colliery could work the 9½ foot seam in 10 yard banks because of the stronger roof and as a consequence the '... produce is more and the coals cleaner got.'(66)

The roof was supported by wooden punches or props that were usually removed as the workings were abandoned, with the colliers receiving additional rates for such dangerous work. Metal punches were adopted only slowly in the

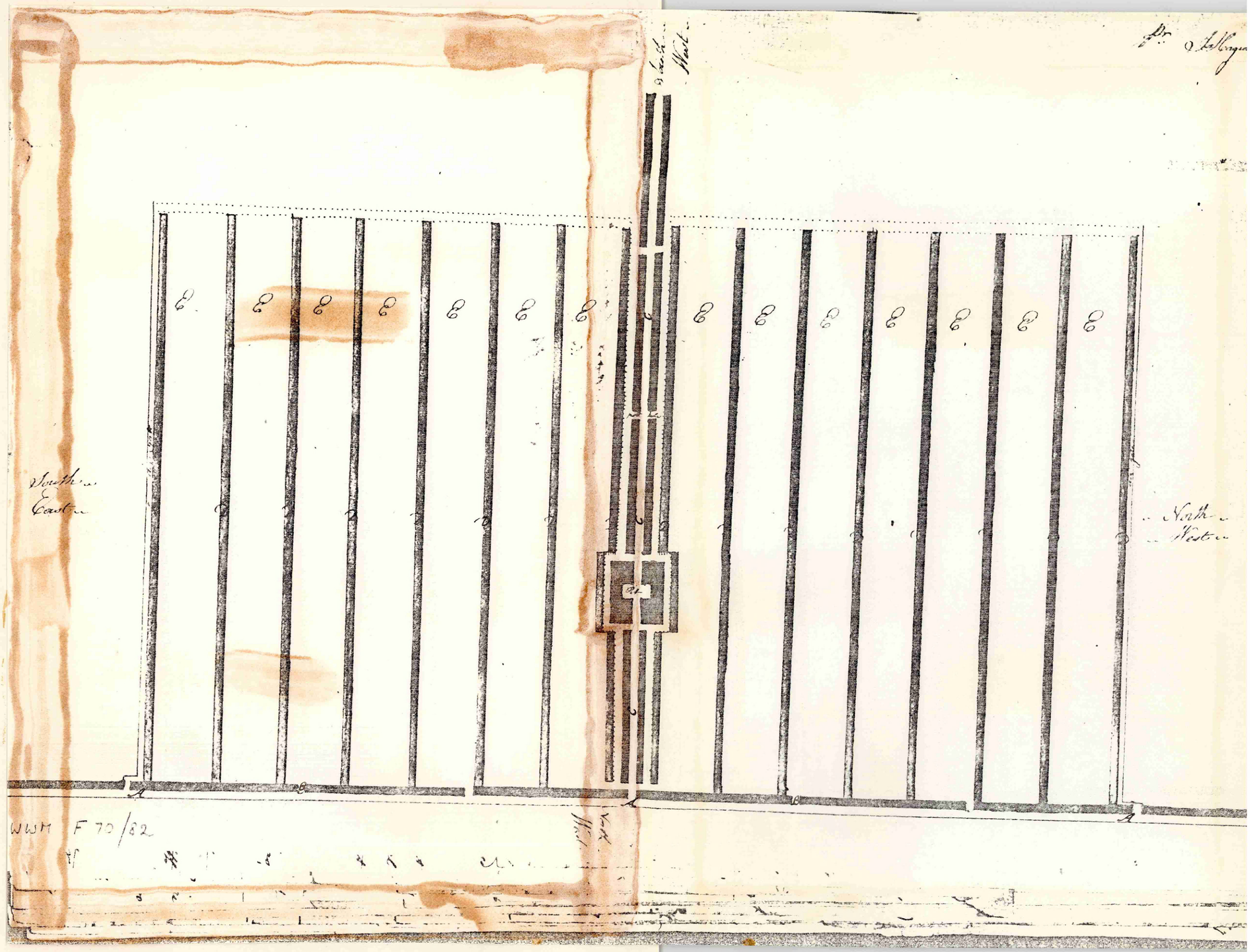


Fig. XII.

LONGWALL MODE OF WORKING, WESTWOOD COLLIERY 1794.

'A Plan of Westwood Colliery Septe^{r}. 9th 1794 Reference

A.A.A. Is the Levell or Water Course and for Air from Pit to Pit, One Yard in Width

B.B.B. Is the Bolt Holes through a Rib of Coal for Air One Yard thick into the Counter Levell where the Banks are taken 60 Yards in Length on each side the Pit Bottom, and no Coal left only that Rib to Support the Levells

C.C.C. A Board gate from the Levell to the Pit Bottom and forwards as far as the Banks are driven upon the Basset to another Pit with a post on each side one Yard thick, with Post holes to convey the Coals from the Banks for Safety to the Pit Bottom and then the Posts are got when the Pit is done.

D.D.D. The red lines are Packs instead of Coal made of Black Shale &c to support the Roof as the Ironstone maybe gotten.

E.E.E. The open places between the Packs are where the Ironstone is to be gotten as the Banks are wrought forwards, the Puncheons are removed forwards And the Roof falling, the Ironstone is gathered out of the Breaches as they fall down every day, but no Ironstone can be gotten in the Packs, only in the Breaches between them

..... The Dots are Puncheons by the Hurry gates one Row and along the Bank faces are two Rows, when a fall of Coals is got down the Low Row is taken out and set formost next the Bank face each day and the Ironstone is gathered out of the Breaches every Day

The black lines are Posts of Coal next the Levell and the Boardgate and round the Pit bottom

P^{r}.. Jos. Hague'

W.W.M. F70/82 S.C.L.

Fitzwilliam collieries in spite of an estimate made by Henry Hartop in 1831 which showed that by substituting the 3700 punches used in the Elsecar Old and New collieries with iron props, the saving could be £70 per annum.(67) Even so, by 1833 only 21 metal props were recorded in the colliery valuations. The management were not convinced of the competitive advantage iron had over wooden props, whilst in addition, the cutting of wood from the Fitzwilliam estate would have provided additional employment and income to the landowner.

Due to the nature of coal mining the advantages created by the division of labour were enjoyed earlier than in many other industries. A clear division of labour could be seen at the Elsecar and Lowwood collieries as early as 1769, although the former colliery employed only some nine workers. The hewers brought down the coal for the fillers to load into the corves which were dragged on sledges or wheeled in barrows by the 'barrower' who hooked the corves onto the rope to be hauled up the shaft. On reaching the pit top the corves were unhooked and carried by the stacker on a horse-drawn sledge to the pit hill. An overseer supervised the whole works, sold the coal, kept the accounts and collected the debts. Hewers, fillers and barrowers were paid according to output with the other workers paid by the day. As the collieries became more extensive, and with the introduction of new capital equipment, there followed a further division of labour with the employment of whimsey tenters, corf menders, corf greasers, blacksmiths, carpenters, packers, hangers-on, hangers-off, horse lads, horse tenters, cinder burners and engine tenters.(68)

Drainage

The problems associated with colliery drainage were to prove the major challenge to engineering expertise in the Fitzwilliam collieries. On several occasions the House steward was unable to foresee the quantity of water coming into the collieries from the surface and neighbouring mines. This

was to result in lost production and additional capital expenditure on new soughs and pumping equipment.

During the eighteenth century the Lowwood and Elsecar collieries were drained by soughs driven up the valley to meet the coal at its lowest point. They were capable of draining large tracks of coal, as in 1790 when Michael Hague, overseer, calculated that a sough one mile in length driven along the Elsecar valley was capable of draining 145 acres of Lowwood coal.(69) Although it was vital to the continued working of a colliery that the sough be kept in a proper state of repair, even direct estate management did not guarantee their correct maintenance. In a report on the Lowwood Colliery in 1790:

> 'The LowWood Sough has long been of little worth - vends but a small Quantity of Water at the Foot it breaks out above where it can find Room - The Elsecar Drain is below that in bad order too & below the Tail there is yet more fall -'(70)

This report appears to have encouraged Fitzwilliam to affect a clearance of the Lowwood sough. Later that year water burst in on some workmen who were removing the blockage, and on hearing about the incident, Fitzwilliam ordered the House steward to pay the workers caught by the water a guinea apiece. In January 1794 the sough was again being cleared when some 700 yards from the new Elsecar pit towards the stoppage had been cleaned. The conditions in the sough were particularly uncomfortable and potentially dangerous, being 'clogged' with mud and 'oker', and in such circumstances one man and three boys worked with a headroom of only 27 inches. The only way of removing the obstruction was by stirring the mud with water and allowing the stream to carry it away. As a consequence, the work was long and tedious being carried out daily 'as long as they are able to bear.'(71)

Prior to 1795 the limited scale and depth of the workings at the Lowwood, Elsecar and Westwood collieries meant they could be drained by a sough with-

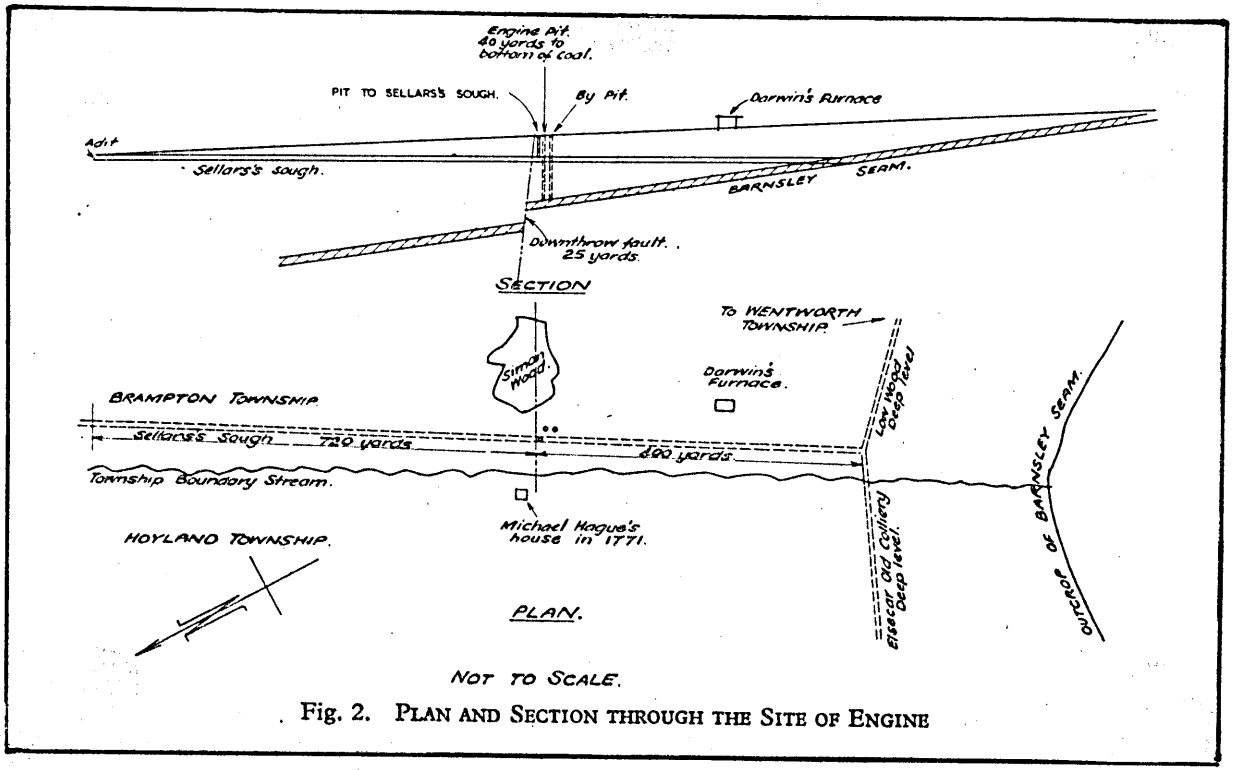


Fig. 2. PLAN AND SECTION THROUGH THE SITE OF ENGINE

Fig. XIII. THE ELSECAR NEW COLLIERY DRAINAGE SYSTEM.

BY COURTESY OF THE NEWCOMEN SOCIETY.

Clayton, Trans. Newcomen Soc. vol. xxxv, 1962-3, 99.

out the necessity to install expensive Newcomen engines. However, a Newcomen engine was erected to drain the Elsecar New Colliery, for not only did the workings discharge a greater quantity of water, but they were located below the level of the existing sough. The water was raised from a depth of 35 yards to the Lowwood old sough by a 42 inch cylinder and Joshua Biram estimated that 386 gallons per minute would have to be drawn by the engine per day over a period of 9 hours 49 minutes.(72)

As the workings of the Lowwood and Elsecar collieries became more extensive they experienced serious drainage problems. In 1799 the Elsecar New Colliery's lower clack in the pump shaft broke causing the colliery to flood, and in 1801, the 42 inch cylinder was found to be insufficient and was replaced by one of 48 inches, supplied by the Butterley Co. The Lowwood Colliery was also temporarily stopped in January 1808, for although a pumping engine had been installed a considerable increase of water had come into the banks at Hoober, which according to Joshua Biram came from the abandoned colliery of Michael Hague. The colliery again ceased working in December 1808 when the pump broke, and the drainage problem became so acute that to take away the excess water, a new sough was driven from Lowwood to the Elsecar New Colliery engine. A major incentive for the purchase of the Southwell Colliery was the possibility of removing the ever present danger of water from the colliery flooding the Lowwood workings and immediately on its acquisition a sough was driven to remove the water.

After a sough was driven from Lowwood to Elsecar, the latter colliery also experienced serious drainage problems. During March 1811 the Elsecar engine was having to work 16 hours in every 24, although the average period of pumping for that time of year should only have been 12 hours. John Woodhouse, engineer, suggested installing three pumps to raise 70-80 gallons at a stroke instead of the present 40 gallons from one pump. It took a further year before the additional pumps were installed and only then after

a further inflow of water from the Southwell Colliery. Two soughs were driven in 1812, along the Clough Valley and from Lowwood into the Southwell workings. Work on the latter commenced in February at considerable speed in three shifts of eight hours each. Even as late as 1823 the Fitzwilliam collieries were not free of drainage difficulties for in that year water in the colliery working the 'Haigh Five Feet Coal Pit' stopped the mine.(73)

As the Fitzwilliam collieries became more extensive so their difficulties associated with drainage became more acute. The vast quantities of water involved the management in major capital schemes on pumping equipment and the construction of soughs to prevent the loss of production, following the closure of the collieries when flooded, whilst the difficulties and expense of drainage as shown in the Fitzwilliam mines illustrate the risks inherent in mining.

Ventilation and Lighting

In comparison to drainage, ventilation did not pose as serious a problem in the shallow Fitzwilliam collieries, as accidents from roof falls exceeded those by gas between 1750 and 1830. The usual method of creating a movement of air was by fire. In 1752 an entry in the estate accounts recorded the purchase of braziers for a pit. It was common practice for these to be placed part way down a shaft to draw out the foul air. A further development came in 1769 in the Elsecar Colliery, when Michael Hague was paid 1s 3d for fetching a fire pan and 'gearing' a pit when it was full of 'Damp'. The Lowwood Colliery was also able to take advantage of changes in atmospheric pressure to drive out accumulations of gas and in October 1793 the steward wrote that the workmen had been 'driven out' of the Lowwood sough by 'damp', '... from which the old works are not likely to be clear till Frosty weather.'(74)

The Fitzwilliam collieries were not without accidents caused by gas, as ventilation under the pillar and stall system of working was generally more difficult than under longwall mining, where the roof was allowed to settle on the old workings. During November 1808 Thomas and George Harrison were slightly burnt while working in the Elsecar New Colliery:

> '... which by its explosion put their candles out and set their work-coats on fire, which men laying at a little Distance from them, one of them had two or three small places on his back burnt so much as to cause the skin to come off...'(75)

The movement of air, after the introduction of long pillar working, was facilitated by post holes struck at specific points along the ribs of coal. Although trap doors were introduced to course air along the work faces the small number referred to in the colliery valuations suggests that many of the old workings were left unventilated.

Another serious threat to the continued working of a colliery came from an outbreak of fire that could ignite any gas present, disrupt ventilation, and lead to a loss of life and production. During May 1805 a fire in the Elsecar New Colliery held up production for several weeks and even when the fire had been extinguished they were unable to enter the workings until the heat had abated. The quantity of combustible material underground made it very easy for a fire to break out, as shown in January 1808 when a collier in the Elsecar New Colliery, whilst going to his work place with a lighted rope was thought to have ignited some hay or straw at the stables by a spark. It was soon extinguished but one of the horses was singed with others affected by smoke. The most particular of safety regulations could not overcome the dangers caused by negligence as claimed was the cause of a fire on Saturday night 25 January 1806 at the Greasbrough Colliery under lease to the Fentons. '... by the Carelessness of one of the Colliers leaving his Candle burning in the Pit which lately fell in and shut up 7 Men & 2 Boys - the fire was not discovered till Monday Morning the

27th Ins. they got some Fire Engines and were trying all last Week to extinguish it ...'(76) There were several methods that could be used to put out underground fires including fire engines, but once the fire was firmly established more extreme action had to be taken. At the Elsecar New Colliery in 1805 it appears the workings were flooded whilst the pit tops at the Greasbrough Colliery were closed, in an attempt to smother the fire. So great was the fire and damage caused at Greasbrough that even by 14 June, some 20 weeks after the outbreak of the fire, they were still unable to get down the pit as many of the sheeting boards and the pit sides had fallen in, although the fire by this time had been put out.

Fitzwilliam took a personal interest in the welfare and safety of his employees as on numerous occasions his letters enquire about the condition of injured workers. Allowances were given to workers until they could resume work with pensions for retired employees or their widows. However, the irresponsible behaviour by some of the colliers could undo the care taken by the management to ensure their safety. In June 1832 Viscount Milton wrote to Joshua Biram that the man responsible for leaving open a ventilation door should be 'scolded', for only a few months previously he had spoken 'severly' when a similar incident had occurred. He insisted on the use of safety lamps in working the gaseous Swallow Wood Coal, and forbid candles in the banks, but although it was not made compulsory for the trammers he thought it adviseable for them to use the lamps. However, in general it was not considered necessary to insist on the adoption of safety lamps in the collieries, but to leave the decision to the individual collier. The colliers often preferred to use ordinary lamps and candles as the more intense light emitted, enabled the extraction of more coal and so increase their wages. In relation to the Fitzwilliam collieries it is not possible to be as enthusiastic as N.K. Buxton who states that the safety lamp '... was one of the outstanding achievements of an age not altogether unfamiliar with spectacular technological improvements.' Nor was it so eagerly welcomed as

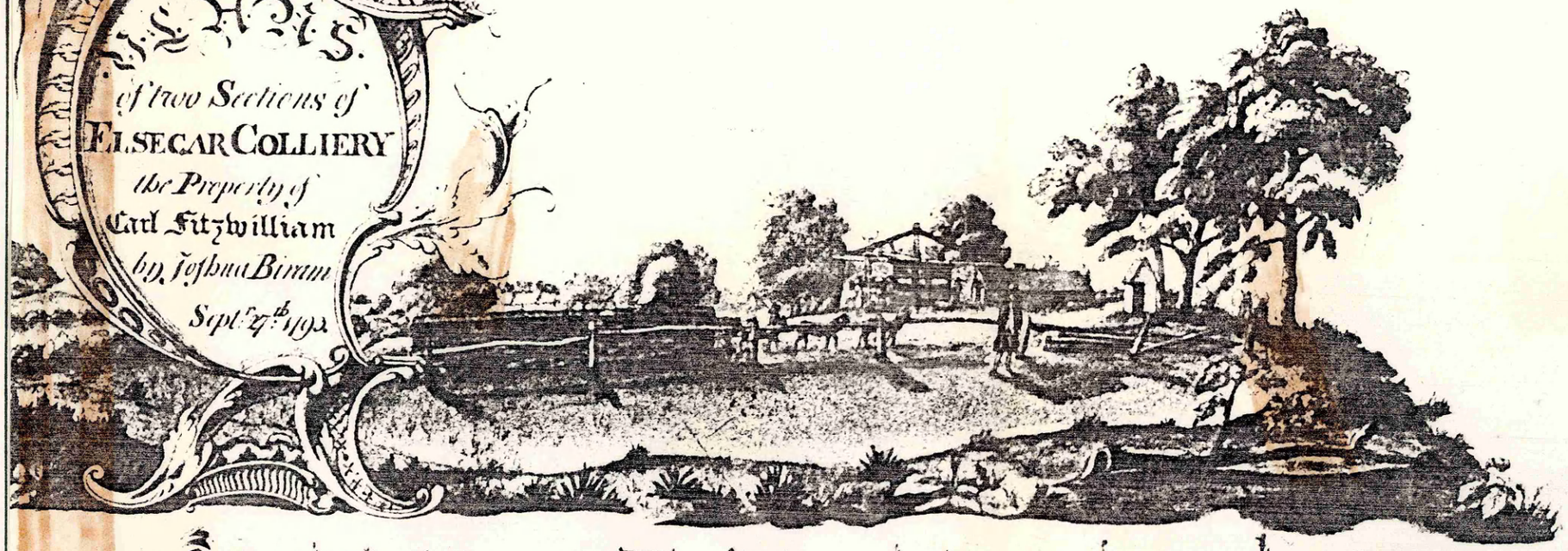
it appears to have been in some other coalfields. The Elsecar New Colliery valuation in 1833 records only 11 safety lamps with six cotton lamps.(77) The slow adoption of the safety lamp in the Fitzwilliam collieries is probably accounted for by the lack of large accumulations of gas, for in those areas where there was a serious danger the proprietor insisted on their use.

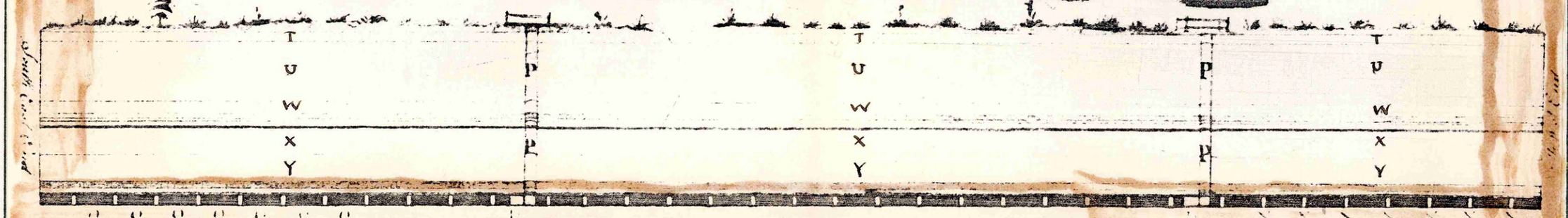
Underground Haulage and Winding

Prior to 1795 the transportation of coal from the work face to the coal stack remained essentially primitive in character in the Rockingham-Fitzwilliam collieries. In 1750 the corves were manually hauled, on a sledge or barrow by the 'barrower' to the shaft bottom, and wound to the surface by a hand gin. The coal was carried to the pit hill on a horse-drawn sledge, and this form of transport was still in use as late as 1793, at the Elsecar Old Colliery.(78) This was typical of many inland coal-fields where low profits and output did not justify high capital investment on equipment such as waggon-ways and steam winding engines. It was not until 1797, after the opening of the more extensive Elsecar New Colliery, that a steam winding engine was installed.

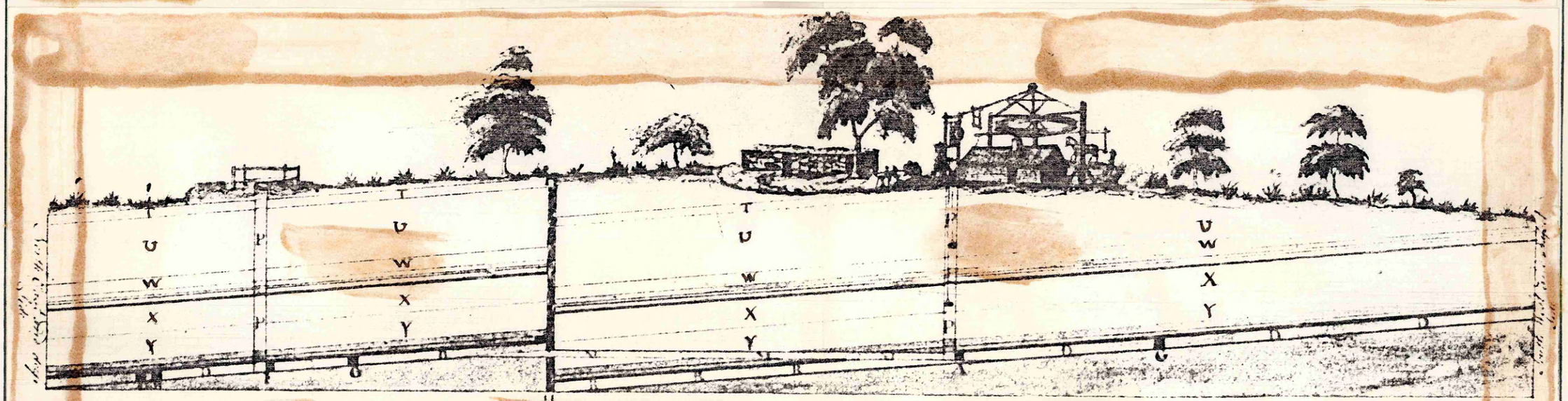
The construction, in July 1754, of a horse driven gin at the Elsecar Colliery assisted in raising the coal more quickly from greater depths. This was still the method used for winding the coal out of the colliery in 1793, with one corf descending as another was raised from a depth of 33½ yards. The estimated cost in 1754 of employing a horse to haul up the corves was 5d per load. This enabled a saving on the previous method as now a boy could be used to look after the horse as previously a man hauled the corves. This change enabled a reduction in wage costs.(79) Even so, it was not until 1769 that a horse was introduced underground in the Elsecar Colliery. There were no further technical innovations introduced into the Rockingham-Fitzwilliam collieries until the dramatic increase in coal pro-

Sections of two Sections of ELSECAR COLLIERY the Property of Earl Fitzwilliam by Joshua Biram Sept.r 27th 1793





Between the Crop of the Coal and the Banks and Boundary of the Coal



When the Banks or Boundary of the Coal

Scale of Yards

Fig. XIV. SECTIONS OF THE ELSECAR COLLIERY, 1793. W.W.M. MP 55 S.C.L.

REFERENCE

An Account of the Minerals in Sinking the Pits at Elsecar Colliery.

No.	marked		Yards	Feet	Inches
1	T	Earth and Clay	2	1	1
2	U	Soft Bind or Marle	14	1	11
3	W	Strong Black Shale	3	0	0
4		Soft Blue Bind	1	1	0
5		A shining bright Coal called the first Riding Coal	0	1	6
6		Soft dark coloured Bind	1	1	0
7		A shining bright Coal called the second Riding Coal	0	1	0
8	X	Hard Blue Bind	6	2	6
9	Y	Grey Stone Bind	6	2	0
10		Hard Blue Stone	1	2	0
11		Soft Blue Bind	1	1	0
12		Shining bright Coal	0	1	6
13		Shining bright Coal being the Part of the Bed now getting which make the main Bed	2	1	6
		Which together make the Depth of the Pit	43	0	0

A Description of the Works which the two Sections are made to represent

Marks	
N N	Posts or Ribs of Coal one Yard thick left for the Support of the Roofs of the Banks
P P	Pit or Shaft where the Coals are drawn out by a Gin
Q	Banks eight Yards wide and 7½ Feet high from which the Coals are got
D D	Section across the Board Gates 6 feet wide and 7½ feet high
	Section the Lengthway of the Board Gates 7½ feet high
A A	Levels or Water Courses
B	Counter Level or Counter heading

L	Rib of Coal between Level and Counter Level two Yards thick for a Support to the Level or Water Course
F	An Endway for bringing Coals from the Banks to the Pit Bottom
G G	Cross Gates
H H	A Throw two Yards thick like a curious Wall with the Materials in different Directions, and so compact, that it effectually stops the Water from running through it, it is supposed to rise near the Surface of the Earth, but its Depth is unknown and the strata is so changed on the South West or Basset Side of the Throw that the Main Bed of Coal is thrown down ten Yards on that side.
M M M	Sough from the Throw to recover the Coal on the South West Side of the Throw
R R R	The Bed of Coal below the new Level on the South West Side of the Throw

W.W.M. MP55 S.C.L.

duction following the construction of the Dearne and Dove Canal. The early innovations involved little expenditure and the major capital asset, the whim gin erected in 1769, was still in use in 1780 valued at £15-0-0.

After the opening of the Elsecar New Colliery in 1795 and the extension of the Lowwood and Elsecar Old collieries the increased output of coal demanded a quicker and more efficient method of moving the coal from the workface to the pit head. Although a whim gin was installed at the Elsecar New Colliery in 1796, it was almost immediately substituted for a steam whimsey, followed by another erected in 1798 at a second bye-pit. A further steam whimsey was erected at the Lowwood Colliery in 1798.(80) Conductors were introduced into the Elsecar New Colliery to facilitate the rapid and safe movement of the corves in the shaft, and by 1833 all Fitzwilliam collieries were using the system. Flat ropes were adopted, supplied mainly by William Chapman & Co. of Newcastle. The more specialist pit ropes were purchased outside South Yorkshire, but from 1815 patent pit ropes were being supplied by John Curr the inventor of the flat rope.

Whilst considerable capital was invested in opening, extending, and purchasing collieries, little effort was made to standardise corf sizes. A greater standardisation of corves would have allowed them to be interchanged between collieries and produced some economies of scale in manufacture. The introduction of steam winding engines did enable larger corves to be introduced to raise output and reduce the costs of haulage.

Surface Haulage

The full corves on reaching the pit head were emptied into waggons and carried along iron waggon-ways and deposited with the aid of rollers and tiplers into canal barges. The tipler system was introduced initially, by John Curr in the Sheffield collieries. In March 1799 it was ordered that:

'The Pit Top at Elsecar New Colliery to be raised 12 feet and a double Rail Road laid from thence into the Bottom of Simon Wood about 10 yards to the East of the Engine tenders House and from thence a single Road upon Standards and Rollers with movable Tiplers for putting Coals into a Battery according to a Plan delivered to John Fallding by Mr Deakin.'(81)

The introduction of surface waggon-ways facilitated the movement of coal, especially in the winter months, and created a more stable supply of coal to consumers throughout the year. The absence of waggon-ways put coal sales and production at the mercy of the weather, and the availability of waggons or carts. An additional hinderance to coal sales was commented upon by Joshua Biram when writing about the Rainber/Brampton Colliery and the shortage of labour and carts in 1819:

'... good sale while wet weather lasted but People being now busy with their Fallows it has abated, yet a Waggon Road to the Canal, I apprehend will be a means for disposing of more there.'(82)

The adoption of the horse drawn four-wheeled corf on underground waggon-ways increased both the quantity and speed at which the coal could be moved from the work face to the pit shaft. At the Elsecar New Colliery, 14 horses were employed with some 658 corves, whilst between 1822 and 1827 the New Park Gate Colliery purchased some 15 horses. This enabled an increase in productivity for it allowed more hewers than hurriers to be employed. In 1808, for example, the Middleton Colliery employed some 90 hewers to 60 putters, and at the Heaton Colliery in 1806 there were 143 hewers to 84 putters. This was also the case at the Elsecar New Colliery where 21 hewers were employed to 16 trammers whilst at the Elsecar Old Colliery the ratio was 11 to 7 respectively in 1813. These technical innovations were also introduced into the other Fitzwilliam collieries at Rainber, Swallowwood and New Park Gate, that were opened during the early nineteenth century.(83)

Prior to 1830 the major advances occurred with the adoption of improved winding and haulage techniques and the introduction of Newcomen type pumping engines. Although the collieries were not in the forefront in the introduction of technological innovations, by 1810 they represented one of the most advanced colliery undertakings in South Yorkshire. Without these improvements by a proprietor prepared to invest considerable capital in his collieries, full advantage could not have been taken of the rapidly expanding coal market. This was reflected in the vast increase in coal output for the total production of the Elsecar and Lowwood collieries in 1769 amounted to 12379 tons which had increased by 1781 to 19438 tons, and by 1826 to 42712 tons. Over the period 1769 to 1826 the total output of the directly managed collieries had risen by 1045 per cent to reach 141806 tons.(84)

Summary

The factor common to both the Norfolk and Fitzwilliam collieries was that the landed proprietors took into direct management mines that were technologically backward, especially those on the Wentworth estate. In addition, Norfolk took 'in hand' an enterprise that was experiencing serious financial and geological problems. However, once these difficulties were overcome by a proprietor prepared to invest the necessary capital the expanding Sheffield market could be fully exploited. Fitzwilliam, on the other hand, had to await the opening up of a much wider market following the construction of the Dearne and Dove Canal.

As many of the problems associated with large scale mining had not previously been overcome, the proprietor and superintendent of the Norfolk collieries became pioneers in the field of mine engineering and technology. In this respect the Norfolk collieries were fortunate in the employment of such an exceptional mine engineer as John Curr. Certainly the innovations introduced by Curr were supported by John Buddle, senior, the foremost mining

consultant of the day. It is in the light of being a pioneer in mine engineering that Curr has to be seen. He was not only an innovator but someone who was prepared to adopt the improvements made in other coalfields.

When Fitzwilliam entered the field of large scale mining in the late 1790's, many of the initial mining problems had been solved. He was therefore able to benefit by the experience of other colliery proprietors and adopt those innovations that had been tried and tested. However, Fitzwilliam, unlike Norfolk, did not have the advantage of taking 'in hand' already extensive collieries. In his case he had to move from mining on a very small scale to create some of the largest mines in South Yorkshire.

The Norfolk and Fitzwilliam collieries provide a comparison between two concerns that employed different methods to extract the coal. The former adopted the longwall system, whilst Fitzwilliam generally employed the relatively inefficient pillar and stall method of working the coal. However, the cost efficiency of the longwall method was more than countered by the adverse geological conditions and greater depth of working the coal around Sheffield, when compared to the Fitzwilliam collieries.

Both concerns experienced difficulties associated with transportation and drainage, with the latter being the more intractable. Whereas the Norfolk collieries required a cheaper method of carrying coal into Sheffield the Fitzwilliam mines needed a more efficient mode of carrying coal out of the Elsecar valley. These problems were overcome by the construction of a waggon-way and canal respectively. A major technical problem lay in drainage, and it was in this field that both landed proprietors expended considerable capital sums and experienced lost production and revenue. There were extraneous causes for their drainage problems, as much of the water entering the workings came from neighbouring collieries, which necessitated additional pumping engines and soughs.

Although the Norfolk collieries were the pioneers in mine engineering and technology, Fitzwilliam was a proprietor with the necessary capital and initiative to adopt the latest innovations in the exploitation of his coal resources. It can be stated that both proprietors advanced the science of mining, which enabled coal to be exploited on an even more extensive scale after 1830.

CHAPTER FIVE

THE MARKET FOR COAL

The Norfolk Coal Monopoly

The large scale exploitation of the inland coalfields depended upon the growth of manufacturing industries, the introduction of new processes, the adoption of coke, and improved means of communication. During the seventeenth century coal was substituted for charcoal in the brewing, distilling, brick, tile, pottery, salt, sugar, soap, glass, non-ferrous metal, nail, hardware and cutlery industries. Whilst the South Yorkshire coalfield in particular, relied upon developments within the iron industry where coke was substituted for charcoal after 1750, even so the full potential of the new markets for coal were not realised without reciprocal improvements in transport from turnpike and canal schemes.(1)

It was the inland collieries located close to navigable waterways or large local markets that could be worked on an extensive scale. Otherwise, the high cost of road transport severely restricted markets and economic development. For example, the cost of leading coal by road from the Duke of Bridgewater's Worsley Colliery to Manchester doubled the pit head price, and to the average price of 2s 5d per load at the Sheffield Park Colliery in 1773 a further 2s.6d was added for leading it a distance of two miles into the town. Even by the last decade of the eighteenth century William Dunn, a Sheffield engineer, estimated that the 'Small' and 'Great' coal at the Dore House Colliery would cost 1s 8d and 4s 2d per ton respectively at the pit, but its carriage into Sheffield, a distance of 4 miles, would raise the price by a further 4s 2d per ton.(2)

Collieries adjacent to navigable waterways were able to take advantage of cheap bulk movement of coal to widen their geographical markets. Pits

around Wakefield and Leeds, for example, used the Aire and Calder rivers, whilst collieries near Ashby-de-la-Zouch sent their coal down the River Trent to Newark, Gainsborough and Lincoln. By connecting the rivers Douglas and Ribble in 1742, the Douglas Navigation enabled the development of the Lancashire Coalfield with the opening up of new markets in the Fylde, Liverpool and Kendal districts.(3) Likewise, the completion in 1751 of the Don Navigation between Fishlake and Tinsley, created extensive new markets in Lincolnshire, North Yorkshire and along the East coast, which in turn encouraged the sinking of several large collieries in the Don Valley around Rotherham, Park Gate, and Greasbrough.

However, the Sheffield collieries of the Duke of Norfolk provide an example of how a large local industrial and domestic market, rather than a navigable waterway, could lead to mining on a substantial scale. Since the seventeenth century, Sheffield had been a centre of the cutlery and fine-edged tool trade, and after 1750 the local coal market was further stimulated by the expansion of the iron and steel industry and the use of coke in the production processes. The expansion of the Sheffield manufactures was recorded by Arthur Young in 1767, who referred to foundries making plough shares, boilers and pans, a pottery with two collieries supplying their needs, whilst over the previous twenty years the number of forges had increased by seven, tilt hammers by two and grinding-wheels by eleven.(4)

The major eighteenth century wars also provided a stimulus to the iron industry through government munition orders which in turn raised the demand for coal. According to Ashton, '... most of the great new works based on the use of coke for smelting and refining were brought into being in 1756-63, 1775-83 and 1793-1802.'(5) Although war had a stimulating effect on the iron and steel industries, in the short term, the burst of

productive activity was not sustained at the termination of hostilities because of the problem of over-capacity. As the duration and intensity of wars in the eighteenth century increased so did their post war effects. This was particularly noticeable in the coal and iron industries after the French Revolutionary and Napoleonic Wars, when the government failed to renew munition contracts. The depression of 1816 was compounded by a sharp decline in foreign trade, especially in hardware and cutlery goods to America in 1817 and following a short upturn in 1818, plummeted further in 1820.(6) This pattern can be traced among the manufacturers and collieries in Sheffield. The Seven Years War of 1756-63 created sufficiently favourable conditions for Roebuck to establish the 'lower iron works' and for Walkers in Rotherham to increase their output of castings from 308¼ tons in 1755/56 to 432¾ tons in 1759/60.(7) However, collieries were unable to take full advantage of the rise in iron production, as charcoal was still the major source of fuel in the blast furnace, although demand for coal did increase in some of the secondary processes. For example, there was an increase in output from the Sheffield Wood Pits from 139,500 corves (5449 tons) in 1759/60 to 158,100 corves (6,176 tons) in 1763/4, but the termination of hostilities saw a downturn in the activity of the iron industry, and as a result coal output fell to 150,700 corves (5,887 tons) by 1764/5.(8)

A similar surge in industrial activity followed the outbreak of the War of American Independence with the erection of new ironworks in Yorkshire and North Derbyshire. The reciprocal increase in demand for coal can be seen at the Hesley Colliery, which supplied the Chapel Furnace, whose proprietors paid an additional rent of £61-6-0 for working more 'pitmen' than was warranted by the terms of their lease. The danger of relying on government munition contracts however, was illustrated by Walker's Masborough ironworks. Out of a total output of 1,221 tons in 1781, three-fifths of the metal cast went to the government. As a result there was a desperate search

for new markets at the cessation of hostilities.[9]

The impact of government munition contracts on the Sheffield iron and coal industries must not be over-emphasised, for although they had a growing influence on trade as the century progressed, the major market for iron and steel lay with the cutlery and fine-edged tool manufacturers. These were susceptible to any disruption of their overseas markets, which in turn had an adverse effect on the local demand for coal and iron. Although the end of the American War brought a depression among ironworks dependent upon government contracts, the reopened North American market raised demand in the cutlery and fine-edged tool trade. A sign of this renewed trade came in 1783 when Booth and Co. planned to erect an iron furnace in Sheffield Park, and the Sheffield Park Colliery raised coal output from 10,693 waggons (16,039 tons) in 1783/4 to 14,344 waggons (20,682 tons) in 1784/5.[9a] The ensuing boom resulted in an acute shortage of coal supplies. Therefore, Norfolk decided to take advantage of the favourable markets to open a large colliery at Attercliffe in 1786.

The declaration of war against France in 1793 and the disruption of overseas markets, had a particularly severe effect on the Sheffield industries. Even by 1796 the Sheffield trades had not recovered. There was high unemployment in the town and a dramatic fall in output from the Norfolk collieries. The disruption of the cutlery and fine-edged tool market largely accounted for the fluctuation in output at the Sheffield collieries between 1793 and 1798. However, as the French Revolutionary and Napoleonic wars progressed the shortage and high price of iron led to the erection of new ironworks and the increased demand for munitions, cast iron engine parts, and colliery equipment, which assisted in alleviating the effects of interruption to the cutlery and fine-edged tool trade. Even the cutlery trade on the opening of new markets in North and South America and intensive smuggling

into Europe was able, for a time, to recover and flourish. The boom in the cast iron and cutlery sectors produced a rapid increase in coal sales at the Sheffield collieries between 1797 and 1801.

Trade was again severely hit by the American trade embargo of December 1807 and a tightening of the Napoleonic blockade in 1810.

> 'During 1809 and 1810 the Sheffield cutlery trade had been at the height of prosperity: in spite of the offer of high wages there had been an acute shortage of labour, and demands had even been put forward for the relaxation of apprenticeship regulations', ... But in 1811 and 1812 a profound gloom had settled on the town, and the distress among the metal workers was intense.' (10)

There was an almost 50 per cent fall in output from the Sheffield converters and refiners, whilst the Thorncliffe Ironworks saw its profits decline from £7,471 in 1810/11 to £6,000 in 1811/12.(11)

A fall in the output of iron had a profound impact on coal sales, for although there are no figures available for the Sheffield collieries, some indication of the state of the coal trade can be seen at the Elsecar ironworks where demand for coal declined from 12,777 dozens (26,832 tons) in 1811 to 5,665 dozens (11,896 tons) in 1812.(12) The breaking of the continental blockade and the coming of peace in 1815 produced a temporary rise in overseas trade and a recovery in the coal and iron trades, but over capacity and a decline in orders produced the depression of 1817 and recovery had to await more stable and long term markets.

Another factor which led to large scale mining development was the rise in Sheffield's population, which increased from 10,000 in 1725 to 46,000 in 1801 and 92,000 by 1831. This provided an expanding domestic market. A further not inconsiderable market for Sheffield coal could also be found among the local maltsters and farmers and finally the construction

of houses, collieries, iron and steel works in Sheffield after 1750 raised the demand for bricks and consequently for coal. On the Norfolk estate the number of brickyards increased from four in 1778 to eight in 1786/7.(13)

The Sheffield estate of the Dukes of Norfolk provided a revenue made up of a large proportion of industrial rents; this was unusual for eighteenth century landed estates. These industrial rents came from enterprises such as forging, furnaces, brick-making, cutlers-wheels, potteries and coal. During the year 24 June 1761 - 24 June 1762, for example, the total rents from the Sheffield estate amounted to £13,206-5-7½ of which the forges and furnaces contributed £3,851-9-0½ with the Sheffield Park and Manor collieries adding a further £1,150-0-0. Industrial rents thus provided £5,001-9-0½ or 37.87 per cent of total revenue. The estate also leased several small collieries whose output supplied either the locality or the immediate needs of their proprietors. At Fulwood, George Smilter paid £3-3-0 per annum for a colliery that provided coal for his pottery on Attercliffe Common and a brickworks near Sheffield Moor whilst at Chapeltown the Hesley Park and Parkin Wood collieries were leased to Richard Swallow, the proprietor of the Chapel Furnace. The latter provided an early example of an integrated coal and iron enterprise.

The more extensive Norfolk collieries reserved the right to supply other industrial and domestic consumers on the estate. In 1773 the Sheffield Park Colliery supplied '... all the cutlers, and about one half of the houses in Sheffield with coals ...' whilst the remaining houses were provided by a rival colliery on Attercliffe Common worked by Oborne, Smith and Clay. The Manor Colliery supplied the local farmers and maltsters and to the south of Sheffield Park production from the Gleadless Colliery, under lease to John Rotherham, was sold to neighbouring farmers with little or none coming into Sheffield to compete with the other Norfolk mines.(14)

Landowners during the eighteenth century usually held a monopoly of coal supplies on their estates, which was of prime importance on those inland coalfields where markets were restricted by the high costs of transport. Such monopolies partly explain the high profits that several landed colliery proprietors acquired during the late eighteenth century. A further method of obtaining a monopoly of a local market was by the acquisition of the sole right to construct a waggonway from the colliery to its market. For example, Charles Brandling, proprietor of the Middleton Colliery, obtained by Act of Parliament in 1758 the right to construct a waggonway into Leeds. The reduction in transport costs gave Brandling a competitive advantage over neighbouring collieries which had to pay turnpike and canal tolls. This was illustrated at the Hatton Colliery in 1778 where coal could be sold at the pit head for 8s per waggon but in order to carry it into Leeds an additional 4s was charged, whereas the maximum price of Middleton coal was only 11s per waggon.(15)

The Norfolks held a monopoly of the Sheffield coal market due to their extensive properties in the Sheffield district and were therefore able to limit competition. Leader summarised the Norfolk attitude to other colliery proprietors as follows:

> 'A monopolising policy inspired the Dukes, while desirous of getting their own coals to the town, to place impediments in the way of others, even of their own tenants. They used the roads through the Park for their own coals, but stopped the people of Handsworth and Gleadless when seeking to avoid the long detours by Newfield Green and Healey'.(17)

The high cost of transport discouraged all but local collieries from sending coal into Sheffield, a situation which the Norfolks used to their advantage to protect their monopoly and restrict competition, and so they prevented

turnpikes, canals and railways from crossing the estate. This obstructionist policy towards transport schemes can be seen in their opposition to the Don Navigation when obstacles determined the Navigation Company to terminate the waterway at Tinsley some 3 miles from the town centre. Essentially this protected the Norfolk monopoly as the cost of leading coal from Tinsley made it uneconomic for collieries outside the area to send coal into Sheffield.(17) Furthermore in 1836 Norfolk strongly attacked the Sheffield to Rotherham Railway Bill that threatened the final demise of his coal monopoly. On the other hand Norfolk was prepared to support those transport schemes such as the Sheffield to Manchester Railway that promised to open up the Lancashire coal market.(18)

The major competitor to the Norfolk collieries was the Spencer or Darnall Colliery. This mine worked the Barnsley seam, a superior hard coal which could be sold in the 1750's at the higher price of 5s 6d per load (17.75 cwts) compared with the price of other coals of between 2s 6d to 3s 2d per load. William Spencer of Bramley Grange leased the Colliery on 12 May 1757 to Walter Oborne, Joseph Clay and Jonathan Smith for 200 years to mine coal under the commons and waste grounds of Attercliffe and Darnall.(19) So successful was the competition from this mine that in 1762 Norfolk, as lord of the manor, tried to prevent the proprietors crossing Attercliffe Common. The case put before counsel, with a view for action for trespass, stated that Spencer's tenants:

> "... sell a deal of coal into the town of Sheffield in prejudice of the Duke's colliery in Sheffield Park, and they carry the coals upon horseback, also in waggons and carts over the part of the Common belonging to the Duke, because it is a great deal nearer Sheffield than the common high is."(20)

Eleven years later the Darnall colliery still posed a major threat to the Norfolk monopoly by supplying approximately half the houses in Sheffield

with coal. This position was largely achieved by its lower transport costs, for lying some 2 miles east of Sheffield the colliery was able to use the nearby turnpike road without the burden of road maintenance costs. In comparison the Norfolk lessees were obliged to repair the roads in Sheffield Park over which their coal was carried.(21) In order to overcome this economic disadvantage Norfolk and the lessees constructed a waggonway 2 miles in length from the Sheffield Park Colliery to the coalyard in the town. Even so, competition from the Darnall Colliery was not eliminated until June 1798 when Norfolk and Eyre purchased the mine. This not only removed a major competitor but raised the Norfolk mineral revenue, prevented another rival acquiring the mine and further consolidated their coal monopoly.

On several occasions the Norfolk coal monopoly came under strong criticism, especially from the Sheffield manufacturers, for not supplying sufficient quantities of coal at a reasonable price. As a monopolist Norfolk was able to restrict supply to keep up the price of coal. There was some truth in the manufacturer's accusations, for in the local iron industry boom between 1792 and early 1793, the shortage of coal was so acute that it prevented the 'regular' working of several steel furnaces and manufactories.(22) In 1792 alone, the 'Dross' coal from the Sheffield Park Colliery rose from 15s to 17s 6d per waggon (30 cwt) and the small coal from 10s to 11s 8d per waggon. This prompted William Dunn to suggest that to prevent a '.... repeated Advance upon Coal ...' every manufacturer should try and stop the rise in coal prices and as a consequence several manufacturers looked for alternative supplies. Dunn calculated that the Barnsley coal at Dore House could be sold in Sheffield for 5s 10d per ton of small and 8s 4d per ton for the 'Great' coal. The scheme appeared so attractive that: 'A Number of principal Coal consumers convened a meeting at which they agreed to purchase 110 acres of that excellent Bed of Coal of Mr. Tho^{s}. Ward called D.H. Coal.'(23) The number and variety of businessmen holding shares in the

Dore House Colliery gives some indication of the unease about the supply and price of Norfolk coal. These included two refiners, seven steel makers, four merchants, two iron-founders, and three cutlers. Production commenced in 1793 in direct competition to the Attercliffe Colliery, supplying the Barnsley coal that was particularly valued by the steel manufacturers. The success of the colliery was only short-lived, for although the proprietors were able to produce coal more cheaply than the Norfolk collieries the depression of 1794 resulted in insufficient demand for profitable production. In addition, the state of the roads over which the coal was carried into Sheffield not only raised the cost of transport but threatened regular supply during the winter months. After working for some 7 to 8 years the colliery was eventually bought out by Norfolk in 1801 for a sum of £5313-10-0.(24) Whilst unsuccessful in breaking the Norfolk monopoly the Dore House Colliery did succeed in slowing down the rapid rise in coal prices, and John Curr blamed the Colliery for the decline in profits at the Norfolk collieries:

> 'The loss to themselves in Interests and money sunk has been about £8,000, but the loss sustained (in being deprived of their consumption, and in keeping down the price of Coals) has been 3 times as much to the Duke's Collieries.'(25)

The acute shortage of coal in 1792-3 also encouraged several Sheffield charity clubs to contribute their subscriptions to opening a colliery at Intake, close to the south entrance of Sheffield Park, to take advantage of the high coal prices. However, high production costs soon persuaded the subscriber to dispose of the colliery for £2,500 to William Newbold and William Holdsworth. Since it was a relatively small concern, it did not pose as serious a threat to the Norfolk collieries as the Dore House Colliery. Newbold and Holdsworth were also faced with high transport costs for unlike the Norfolk collieries they had to pay a toll on sending coal through

Sheffield Park, and in order to remain competitive they were forced to sell their coal ½d less to the coal leaders than they would otherwise.(26)

In allowing the turnpike road to be constructed through Sheffield Park, Norfolk ensured that his colliery interests would be adequately protected. Not only were his lessees to be exempt from payment of tolls in the Park but the road could be deviated by 50 yards to work any pits at the expense of the trust, whilst waggon-ways could be constructed across the road to convey coal into the town. Several attempts were made during later renewals of the road act to eliminate the advantage held by the Duke. In 1799 for example, an unsuccessful move was made by a group of colliers, merchants and the proprietors of the Intake Colliery to remove either the toll or the exemption. Again in 1821 the trustees tried to force the Norfolk lessees to use broad wheeled carts of at least 5 inches in width instead of the narrow wheels that damaged the surface, and to introduce a 'half toll' in the Park for the Norfolk lessees.(27) The lessees promptly took advantage of a clause in their lease, whereby they could call on the Duke to use his influence against any transport scheme that was not in their interest. They complained that any additional toll would be 'injurious' to themselves and the Duke as they would either have to raise prices and so give an advantage to their competitors or reduce profits. To a certain extent the lessees could be accused of hiding behind Norfolk influence to retain their monopoly position. Although the lessees were aware that a railway would overcome the threat of increased competition they had postponed any such development on account of the cost involved and also the danger of coal leaders damaging the railway. Even by 1830 they had not constructed a railway although one was in the process of being built from the Sheffield Canal basin to the Manor Colliery. When George Stephenson assessed the mode of transporting coal into Sheffield in 1830 he commented that the 10d per ton 'considerably exceeds' the usual price of 6d per ton per mile. 'This cir-

cumstance it might be supposed would have long before this, suggested the adoption of a Railway with self acting inclined planes ... when, however, the nature of the other part of the distance is considered towards the Collieries and its suitability, for a Railway, worked by economical machinery, it is surprising that its execution should have been neglected.'(28) He suggested a railway from the Canal basin to the Manor Colliery to the collieries on the high ground and then to those further afield. This was probably an example where a landowner and his lessees by neglecting investment had allowed themselves to be unprepared for competition.

The Norfolk coal monopoly was further reinforced by insisting that wherever possible, manufacturers who leased land on the Sheffield estate, purchased coal from his collieries. In 1763 a lease granted to Booth and Co. to erect an ironworks in Sheffield Park, stated that coal must be purchased from a Norfolk colliery if one was opened nearby. Booth and Co. were to:

> '... hereby agree That if ye said Duke shall have any Colliery carried on and wrought which shall be as convenient cheap and a good Coal for their use as any other Coal or Colliery. In such case to have and buy all the Coal they shall use and consume in carrying their Trade & Manufactory on the aferss^{d}. Premises from the s^{d}. Duke's Collierys'.(29)

A further lease was granted to Booth and Co. in 1784 enabling the proprietors to mine their own coal and iron, but after spending upwards of £3,000 in an attempt to sink a pit the quantity of water which was encountered forced it to be abandoned. Another attempt was made, on the bassett side, at considerable expense, but the quality of coal extracted proved disappointing, whilst the huge quantity of small coal produced was sold in direct competition to the Manor Colliery. This competition proved sufficient for Norfolk to insist that the pit should be closed without compensation, even though

the proprietors thought their small coal complemented the Attercliffe Colliery sales.

> 'The Coalery was stoped, the Engines pull'd down and sold whereby the Com.^{y} sustained a Loss of 2067 £ exclusive of the Profit it w.^{d} have left them during the term of their lease which upon a moderate presumption w.^{d} not have been less than 10,000 £'(30)

Norfolk was acting to protect his coal monopoly and in particular the sales of the Manor Colliery, for as the cost of leading from Booth's Colliery was lower, Booth & Co. could charge 1s 4d more to their leaders or lower prices to undercut Norfolk coal. After closure of the Colliery, Booth and Co. had to rely on the supply of coal from the Norfolk collieries whose prices rose rapidly between 1786 and 1804. The difficulties encountered by manufacturers who relied on the restricted coal supplies from the Norfolk collieries can be seen by the experience of Booth and Co. who after considering paying 3s per ton at the coal stage in 1783, stated that:

> 'Keeping this price in mind how the comp.^{y} have fared by being thrown into an open and uncertain Market the following Statement will shew (the Advances hav.^{g} always been made by the Duke and his Partner Mr Eyre)

In the year 1786 Hard Coal at Phipps Clay & Deakins Pit was $4^{s}/4^{d}$ p Cart Load of 26 Cw. or $3^{s}/4^{d}$ p. Ton.

In 1796 Hard Coal at the dukes Pits					5/-	p. Ton
1798	"	"	"	"	6/8	" "
1801	"	"	"	"	7/6	" "
1804	"	"	"	"	9/-	" " (31)

The high price and unreliability of supply from the Norfolk collieries prompted Booth and Co. to take out a lease from Earl Fitzwilliam to mine coal and ironstone on his Tinsley estate and after the completion of the Sheffield Canal in 1821 this colliery posed a serious threat to the Norfolk

coal monopoly.

The peak of Norfolk dominance of the Sheffield coal marketswas achieved in 1801 with the purchase of the Dore House Colliery. Out of approximately 125,000 tons consumed by the Sheffield manufacturers from 16 collieries in 1803, the Norfolk pits accounted for 101,400 tons or 81.12 per cent of the total.(32) This dominance of the Sheffield coal market was to last without any serious challenge until the opening of the Sheffield Canal in 1821 which allowed the more cheaply produced coal carried on the Don Navigation to be brought into the town centre. The Norfolk colliery lessees reacted strongly against the attack on their monopoly by attempting to modify the Sheffield Road Bill. They complained that since the opening of the Canal, several collieries located near the Don Navigation and the Dearne and Dove Canal were sending large quantities of coal into Sheffield. In a letter to the Duke opposing the Sheffield Road Bill the lessees referred to the:

> '... open Collieries of Mr Fenton near the River Don, of Mr Edmunds at Worsbro' which communicate with that River from the Dearne and Dove and from which Collieries large quantities of Coal have been recently imported into Sheffield as well as the Colliery opening by Messrs. Booth, Sayle & Company in Estates of Earl Fitzwilliam near Tinsley within three miles of Sheffield in direct opposition to the Duke of Norfolk's Collieries and also a Colliery of vast extent in the opening of which great progress is made by Earl Fitzwilliam near Wentworth and Rawmarsh ...'(33)

An indication of the economic disadvantage of the Norfolk collieries was revealed by the New Park Gate Colliery which was owned by Earl Fitzwilliam and able to deliver coal at the Sheffield Canal basin at a lower price than the Sheffield Colliery. According to the Norfolk lessees this opposition had prevented any increase in profits and had forced a reduction of 1s 8d per ton at the Handsworth Colliery even though this colliery was the least

competitive on the Norfolk estate on account of its distance from market. In fact the lessees believed they would never recover the capital exceeding £11,000 which had been sunk in the Nandsworth Colliery. There was also increased competition from the south of Sheffield from the Intake Colliery and coal worked by Earl Manvers, and to compound the lessees difficulties, the slump in the coal trade meant that the Norfolk collieries were competing in a dwindling market. Although the post war depression reached its national low point in 1819, the Sheffield cutlery industry did not recover until 1821 following irregular exports to its principal market, the U.S.A. After a revival in trade between 1821 and 1825 there followed a decline in economic activity with a severe recession in 1829, particularly in the iron and coal trades. The effect of the recession was shown by John Buddle who stated that the Tyne collieries were capable of producing as much coal again and the Wear mines half as much again, as their current output.(34) Although by 1829 the Norfolk collieries were experiencing considerable competition and a slump in the coal trade, their monopoly was not finally broken until the opening of the Sheffield to Rotherham railway in 1838. One of the arguments put forward in support of the line included the familiar complaint that the Norfolk collieries were still not supplying coal either in sufficient quantities or at a low enough price.

The development of the Norfolk collieries depended upon the monopoly of their Sheffield market, and whilst this was not necessarily in the interest of the manufacturers, it was in the economic interests of the Norfolk estate. The monopoly allowed coal to be exploited on a more extensive scale and for advantage to be taken of the adoption of coke in the iron and steel industries. A fall in demand and rising production costs could be alleviated by raising prices without fear of competition and supply could be limited to force up the price of coal. With the elimination of most of the local competition by 1801, there was less pressure to reduce costs and improve efficiency which appeared to have left the lessees unprepared for com-

petition when it came. The improvements in transport facilities made it only a matter of time before the Norfolk coal monopoly was broken. Once the Sheffield Canal and the Sheffield to Rotherham railway had been constructed into the town centre, the cheaper coal mined near the Don Navigation and the Dearne and Dove Canal could be brought into direct competition with Sheffield coal.

The Rockingham-Fitzwilliam Coal Market 1750-1830

The Rockingham-Fitzwilliam collieries were typical of many inland coalfields where the lack of cheap transport limited their economic development.(35)

> 'Often enough it was the lack of good roads, and even more of cheap water carriage - so essential for moving heavy and bulky commodities like coal, iron ore, bricks, timber, building stone and agricultural produce - which limited the economic growth of an area.'(36)

Some landed proprietors, such as the owners of the Wentworth estate, with consolidated landholdings were able to hold a monopoly of coal sales on their property, and to a certain extent protect output. Prior to 1798 the Wentworth estate collieries were able to supply the immediate needs of their respective proprietors and communities. The proprietors of the Bolsterstone and Tinsley collieries, for example, supplied their glassworks, whilst the Westwood Colliery provided fuel to the lessees of the Chapel ironworks. This latter colliery continued to remain a small undertaking due to its remote location, high cost of road transport and close proximity to other landowners who sought to safeguard their own coal markets. The high cost of road transport limited the majority of customers to a radius of 3 miles but in the case of two ironworks it was carried a distance of 10 miles. In 1796 the two main customers of the Westwood pit were Swallow and Co. of the Attercliffe and Chapel Ironworks, who leased the colliery between 1784 and 1791, and Booth and Co. the proprietors of an ironworks at Masbrough near

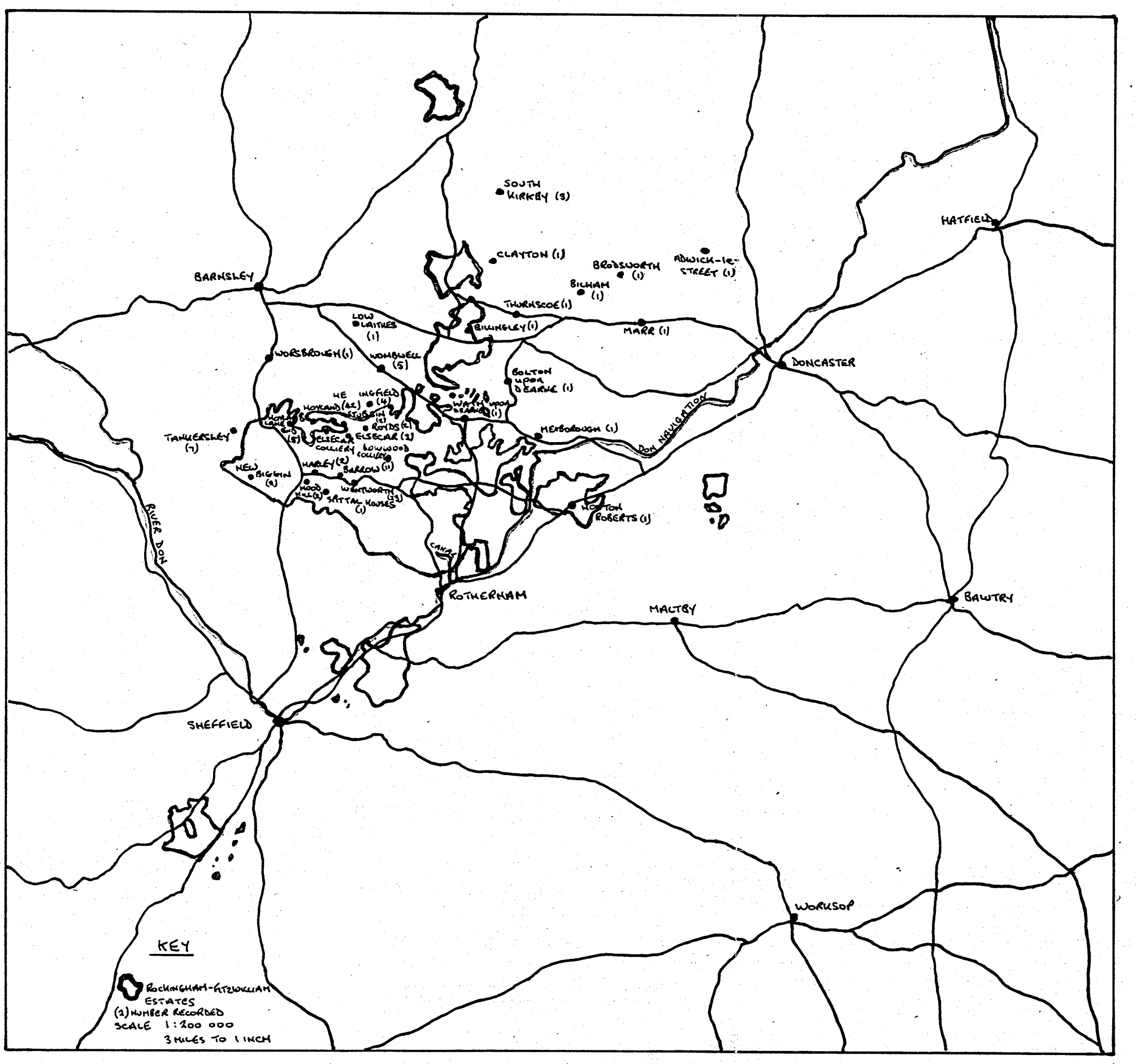
Rotherham. They found it expedient to carry coal such distances, even though there were more convenient sources of supply. Swallow and Co. alone purchased coal for their Attercliffe Ironworks in 1796 to the value of £302-8-0 out of total sales of £745-10-9 or 40.5 per cent of the total.(37) There are several possible reasons for carrying Westwood coal a distance of 10 miles. At 2s 10¼d per ton in 1797 the price compared favourably with 5s 10d per ton in 1796 for Attercliffe coal and in addition it provided an alternative source of fuel rather than being completely dependent upon the irregular supply and high price of Norfolk coal. The diversification of coal supplies also conserved coal reserves near to proprietors' ironworks. The protection and conservation of supply was probably the prime motive for diversification as Swallow and Co. of the Chapel Ironworks not only leased the Hesley and Parkyn Wood collieries from the Duke of Norfolk but purchased coal from Earl Fitzwilliam's Elsecar Old Colliery.

Coal from the Lowwood and Elsecar collieries was mainly consumed on the estate by the local ironworks, forges, farms, lime kilns, brickworks, maltsters, and domestic consumers. The major purchasers of coal in the 1760's included, Wentworth Woodhouse, the Wentworth brickworks and lime kilns at Lowwood, Hoober, Wentworth and Kilnhurst. As an improving landowner Rockingham's demand for lime increased and on Fairbank's map of 1757 two lime kilns were shown just below the present railway station.(38) Shortly after the purchase in 1750 of the Skiers Hall estate and Elsecar Colliery from Mr Monckton, preparations were made for the carriage of coal by cart to Kilnhurst. As the Lowwood Colliery workings progressed towards the Don Navigation more coal was carried on the Wentworth turnpike and then on the waterway to more distant markets, whilst the Elsecar Colliery acquired a major consumer in the Chapel ironworks. In 1798, the Chapel ironworks alone purchased from the Elsecar Colliery 3067 dozens 8 corves (6442.8 tons) of coal amounting to £1288-16-3 or 87.00 per cent of total sales.

The over-reliance on an unpredictable local market encouraged the owners of the Wentworth estate to seek a wider and more diverse coal market. With this in mind several attempts were made to enter the more lucrative London trade, but the high cost of transport effectively barred Wentworth coal from the capital until railways provided a direct link with South Yorkshire. In September 1764 Rockingham calculated that it would cost 6s 6d to convey a Parkgate waggon of coal from Swinton to Hull and a further 10s to transport a London chaldron of coal to the capital.(39) The cost of carriage made it prohibitive and if any Lowwood coal was sent it would have been to fill the vaults of Rockingham's house in Grosvenor Square. Shortly after the opening of the Elsecar New Colliery and Dearne and Dove Canal, Fitzwilliam made further enquiries, but whilst the pit head price was only 4s 6d per 30 cwt its carriage to London added £1-4-8. Undeterred by being unable to break into the London market in 1797, Fitzwilliam again asked Benjamin Hall in 1802 if any '... coal vessels want a venture to the London market ... it will be an opportunity for trying, how either the Elsecar or Parkgate coal will sell in London.'(40)

The cost of carrying coal by road from Elsecar or Lowwood to Swinton and then by sloop to Hull for transhipment to London made the price uncompetitive in relation to coal brought from Northumberland and Durham. As the cost of transport was lower for the proprietors of the Great Northern Coalfield they were able to undercut the prices offered by inland colliery owners to safeguard their London monopoly.

Not only was the London market closed to coal from the Wentworth estate but the cost of transport before 1795 restricted the market for Elsecar and Lowwood coal to a maximum distance of 27 miles. The high cost of road transport was vividly illustrated in 1766 when a dozen of Parkgate coal carried from Lowwood to Swinton a distance of 6 miles cost 5s 8d compared to 4s 6d for the next 30 miles from Swinton to Thorne along the Don Navigation. In



THE MARKET OF ELSECAR OLD COLLIERY BASED ON THE OUTSTANDING DEBTS AFTER TWENTY SIX YEARS FROM 1762 TO 1788

Fig. XV.

fact overland carriage costs proved the major factor in restricting the development of the Elsecar and Lowwood collieries. The effect of being situated near a navigable waterway was shown in 1781, when the annual output of the Elsecar and Lowwood collieries amounted to 2268 tons and 17170 tons respectively whilst the Basingthorpe Colliery alone in 1779/80 was able to send approximately 36126 tons of coal down the Don Navigation.(41)

The Rockingham-Fitzwilliams were aware that only by an improvement in transport could the coal market be extended and their collieries worked on a more extensive scale. They were prepared to join with other landowners, merchants and industrialists in projects which had the potential to reduce costs and facilitate the movement of coal. By 1767 Rockingham had subscribed £3175 to five road trusts and by 1816 Fitzwilliam had increased this to £5200 including £3700 in the Rotherham and Wentworth Turnpike Trust which improved the carriage of Elsecar and Lowwood coal to the Don Navigation. Between 1779 and 1781 Rockingham constructed the Greasbrough Canal to link the Basingthorpe Colliery with the Don Navigation and so reduced the cost of transporting coal from the mine. Following the initiative taken by his uncle, Fitzwilliam took an active interest in the Dearne and Dove and Sheffield canals which directly facilitated the movement of coal on the Wentworth estate. The Dearne and Dove Canal provided access to the Midland canals and markets for Elsecar coal whilst the Sheffield Canal enabled Fitzwilliam coal to enter the Sheffield coal trade.(42)

The importance of location near a navigable waterway was also reflected in the economic development of the Elsecar Old and Lowwood collieries. As the eighteenth century progressed the Lowwood colliery moved closer to the Wentworth turnpike and Don Navigation which assisted in lowering the cost of transport and widening the coal market. As a consequence the colliery was able to raise output in response to increased trade but the Elsecar Old colliery, whose sales remained essentially local, saw only a small rise in

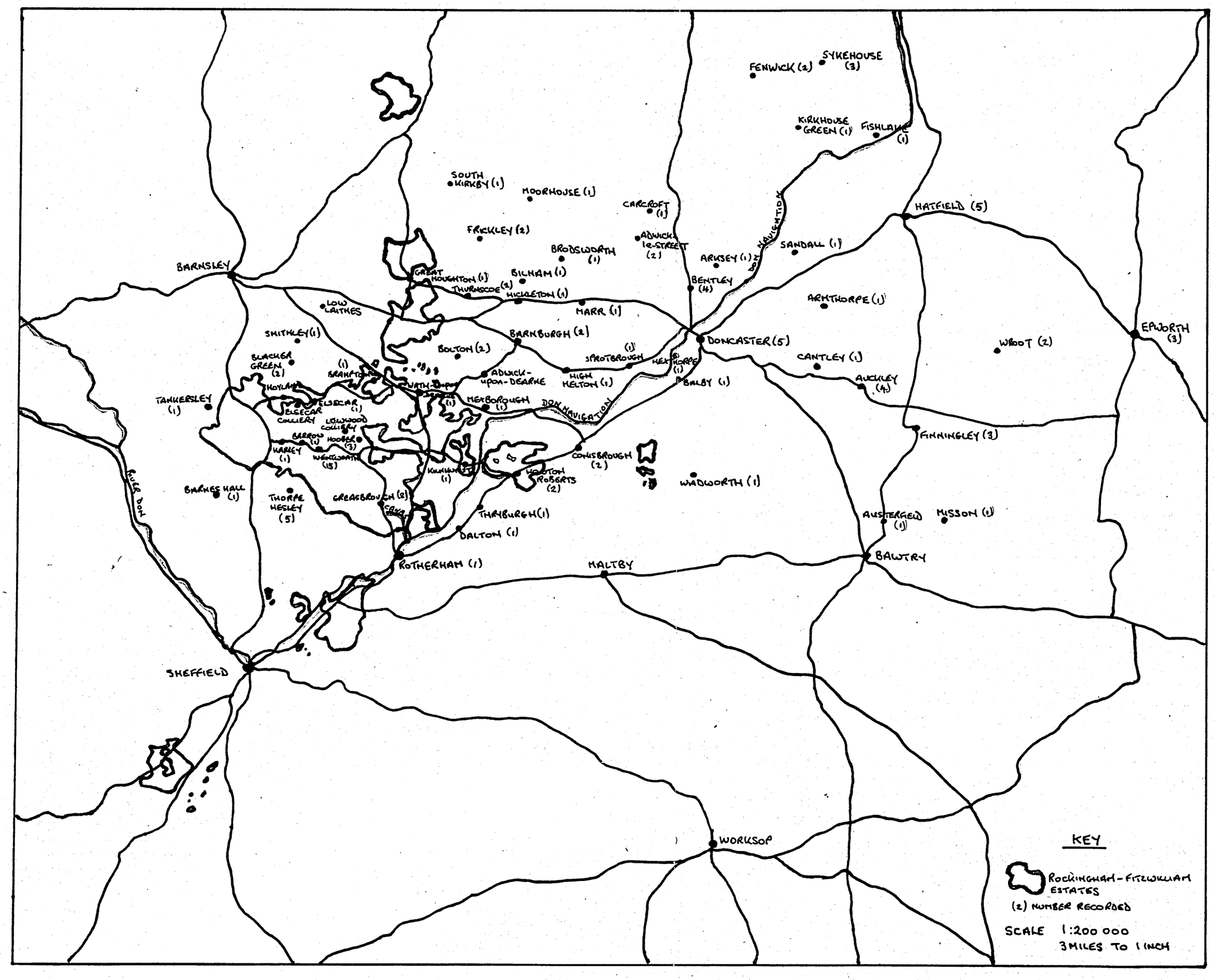


Fig.XVI. THE MARKET OF LOWWOOD COLLIERY BASED ON THE OUTSTANDING DEBTS AFTER TWENTY FIVE YEARS FROM 1763 TO 1788.

output. An indication of their respective markets is reflected in an account that showed their arrears and outstanding debts over 25 years from 1763-88. Out of 137 entries for the Elsecar Old Colliery, 102 consumers were located up to 2 miles distant with only one entry recorded at 14 miles. On the other hand the Lowwood colliery with 115 entries, had 31 customers up to 2 miles with 32 at a distance of between 14 to 18 miles and four entries at 20 miles from the colliery.(43) Although the Don Navigation extended the geographical area for Lowwood coal sales, customers were all located at a short distance from the waterway.

The economic success of the Greasbrough canal, from its opening in 1781, probably encouraged Fitzwilliam to make a survey for a canal to link Elsecar to the Don but the scheme was never carried out. Instead, the Don and the Aire and Calder Navigation companies had a more comprehensive project to join the rivers Calder, Don and Trent with the Humber estuary. The main reason for the scheme was the shortage of coal in the Trent area following a reduction in supply from around Rotherham and the diversion of coal from North Derbyshire southward to the new ironworks at Stavely, Renishaw and Chesterfield. Coal from the Barnsley area would thus provide an alternative source of fuel and allow '... the rich coalfield around Barnsley to be developed and its coal to be transported cheaply into the valleys of the Calder, the Don, the Trent and along the Humber estuary.'(44)

The Dearne and Dove Canal Act 1793 enabled landowners to lay railways to any mine within 1000 yards of the waterway and up to 2000 yards in the parish of Wath, which contained the Fitzwilliam collieries. Of the 211 original shareholders many were landowners such as the Duke of Leeds and the Earl Fitzwilliam who held considerable mineral reserves along the canal. Out of a total cost of just under £100,000, Fitzwilliam provided a loan of £5,000. The canal was completed in its entirety in 1804 but was constructed as far as Elsecar by December 1798.(45)

It was vital for the exploitation of coal on the Wentworth estate that a branch of the Dearne and Dove Canal be taken up the Elsecar valley. The importance of the extension was appreciated by Fitzwilliam who used his influence and carried out protracted negotiations to ensure the branch terminated at the point he desired. Whilst agreeing to extend the branch as far as Cobcar Ing a shortage of funds made the Canal Company reluctant to take it a further 600 yards to the Elsecar New Colliery, as demanded by Fitzwilliam. At the same time the Company doubted whether the extra cost of £2,800 for the extension would return sufficient funds to pay the interest on the capital. In January 1797 Fitzwilliam appeared willing to pay for the extension, provided he could use water from the Elsecar reservoir. This was followed by an abrupt change of mind, and Bowns writing to Hall on 29 June 1797 quoted Fitzwilliam's intention not to proceed with the extension, to stop further stone being worked and to abandon the plan for fixing the 'machine' and sinking a new pit. Eventually an agreement was made between the parties, whereby the canal company was to contribute towards making a new colliery sough at Elsecar with Fitzwilliam paying for the cost of building the canal wharf wall. In addition the cost of extending the branch, which amounted to £3497-10-6, would be advanced by Fitzwilliam as a mortgage on the tolls.(46)

Completion of the Dearne and Dove Canal extended the geographical market for Fitzwilliam coal. At the northern end of the canal a union was made with the Barnsley canal, opened in 1799, which in turn joined the Aire and Calder Navigation. However, the major markets lay to the south and east where the canal enabled Fitzwilliam coal to be carried on the Don Navigation to the Humber estuary or along the Keadby and Stainforth Canal to the River Trent, and from 1821 along the Sheffield canal. The Dearne and Dove Canal enabled the market for Fitzwilliam coal to be extended into Barnsley, Sheffield, Gainsbrough and Lincoln. This was reflected in the quantity of Elsecar coal sent down the canal which in 1810 amounted to 720 tons per

week, and out of a total of 73,384 tons shipped down the Dearne and Dove Canal, Elsecar accounted for 26,462 tons.(47)

Although the majority of Fitzwilliam coal was carried by independent carriers, the estate did construct and purchase sloops to deliver coal and coke and search for new markets. At the New Parkgate Colliery in 1823, a boatyard was erected along with two sloops built in that year to carry coal, and in 1825 another sloop, the 'Six Brothers', was purchased for £275-0-0. Fitzwilliam sloops delivered coal and coke as far afield as Sheffield, Hull, Gainsborough and Wisbech.(48)

A potentially lucrative market for Fitzwilliam coal lay with the Sheffield manufacturers, but the cost of leading coal from Tinsley into the town severely restricted trade to all but those collieries in or around Sheffield. At the Haugh Colliery in 1819 for example, coal cost 7s per dozen at the pit head, but to lead it into Sheffield added a further 7s. These financial obstacles were largely overcome in 1821 with the opening of the Sheffield Canal.(49) Fitzwilliam was quick to take advantage of the opportunities offered by the Canal, and following the high demand and price of coal after 1818, he turned his attention to the exploitation of minerals on the Tinsley estate. A further encouragement to enter the Sheffield market was the fact that coal produced at the Darnall Colliery and from Swallow at Brightside was double the price of Lowwood coal.(50) In light of this, borings were taken at Tinsley which revealed that the coal was not only at a shallow depth, but could be easily drained. The minerals were leased to Booth and Co., proprietors of the Park Furnace, who opened a large colliery working 12 acres per annum of coal for their own works, the surplus posing a serious rival to the Norfolk collieries.

In spite of improvements in transport, coal sales could still be interrupted. For example, in December 1795 the Wentworth Turnpike was badly cut up by coal leaders, other than those from the Lowwood or Basingthorpe col-

lieries, who had been using the road to reach the Dearne and Dove Canal at Cinder Bridge. In December 1806 the roads to Lowwood were in such a poor state that although '... the canal sale at Elsecar has been tolerable good .. the Bad Roads to Lowwood, have almost stopped the sale there.'(51) During the following year Bramold and Co. of the Swinton Pottery asked to be supplied with coal from Elsecar as they were not '... able to get any from Lowwood on account of the badness of the Roads ...'(52) Even sales at Elsecar could be interrupted by ice on the canal. Although the Dearne and Dove Canal increased the geographical market for Fitzwilliam coal its impact must not be exaggerated as toll charges limited inland carriage to Lincoln in the south. Within a relatively short distance canal tolls could more than double the pit head coal price. In 1823, for example, when the price of a waggon of coal at Elsecar was 12s 6d the cost of carriage raised the price at Lincoln to £1-11-6 and at Malton to £1-13-8.(53)

The cheap bulk movement of goods along the Dearne and Dove Canal encouraged the opening of the Elsecar Ironworks in 1795 and the Milton Ironworks in 1803 and this provided a major market for Fitzwilliam coal and ironstone. It was on condition the lessees purchased the estate coal that leases were granted to them to establish ironworks in the vicinity. The lease granted to Darwin and Co. of the Elsecar Ironworks, allowed them to work their own ironstone but they had to purchase coal from an estate colliery if one was located within 1 mile of the works. The lessees were assisted with preferential terms during the early years of their 18 year lease whereby coal could be purchased at 6s per dozen (42 cwt) for 7 years and at 7s 6d per dozen for the remainder of the lease. These terms appeared acceptable to the lessees as the ironworks commenced working in November 1795 when Bowns wrote; 'Mess^{rs}. Darwin & C^{o}. have begun their Blast, and find the metal Extraordinary good, and to answer their fullest expectations.'(54)

The economic conditions in the Elsecar area were so favourable to iron production that by December 1797 another lease was ready for Fitzwilliam's sig-

nature, allowing Walker and Co. to erect an ironworks at Milton some 1½ miles from the canal. The lessees were allowed 2 years to erect a furnace but the opening of the Milton Ironworks took longer than expected and even as late as March 1802 Fitzwilliam was enquiring whether the furnaces had been set to work. The proprietors were obliged to purchase their coal from the estate, which in this case was the Elsecar Old Colliery whose levels were driven to the ironworks.

A fixed price for coal and preferential terms in the early years of a lease allowed the proprietors to plan ahead without the problem of fluctuating fuel costs, whilst at the same time providing a steady income to the lessor. On the other hand, the lessor was prevented from taking advantage of an increase in coal prices until the expiration of the lease, and such arrangements could also work against the interests of the lessees. This was shown by the experience of the Milton Ironworks proprietors. Due to the delay in opening the Milton Ironworks the proprietors lost 4 of the 7 years they were allowed to purchase coal at the reduced price of 7s 6d per dozen. There followed a long wrangle with Fitzwilliam over how long they could purchase coal at the lower rate. Little was achieved by such representations, for in 1804 they were told to abide by the decision given them during the previous year.

In his negotiations with Walker and Co., Fitzwilliam was able to use his monopoly of supply to raise prices, for even if their lease had allowed the purchase of coal from other suppliers further down the canal, the additional cost of transport would have made the price little different from Elsecar coal. Accordingly when the lease, which expired in 1815, came up for re-negotiation, Fitzwilliam was able to insist on the proprietors accepting the market price for coal instead of the previous fixed price contract.(55) After protracted negotiations and accusations by Walker and Co. that advantage was being taken of their Southwark Bridge contract, they

reluctantly agreed to the new price system. Fitzwilliam was taking advantage of the high demand and rising coal prices in South Yorkshire to raise his own mineral income. As a consequence, by January 1815 the Elsecar and Milton ironworks were paying 11s 4½d per dozen of coal which meant that between 1804 and 1815 their fuel costs had increased by 65.9 per cent. By insisting the ironworks purchase coal at the going market price the collieries gained short term financial benefit but these higher prices contributed towards the bankruptcy of the ironworks in 1827, and to protect his coal market Fitzwilliam was obliged to purchase the concerns and expend considerable capital sums.(56)

As the Fitzwilliam collieries were striving for a wider and more diverse coal market they became, paradoxically, dependent upon the fortunes of the local ironworks in Elsecar, Milton, Chapeltown, Rotherham and Sheffield. In particular the Elsecar collieries relied on demand from the Elsecar and Milton ironworks with the Elsecar New Colliery supplying the former and the Elsecar Old Colliery supplying the latter ironworks. This dependence can be seen in 1810 when the Milton ironworks purchased 6615 dozen 11 pulls (13892 tons) or 77.00 per cent of the total Elsecar Old colliery sales and the Elsecar Ironworks 13503 dozen (28356 tons) of coal or 58.00 per cent of the total Elsecar New Colliery sales.(57)

The obvious danger of being over-dependent on the iron industry for coal sales meant that any slump was immediately reflected in sales and output. A depression in 1812 closed all but one furnace at the Elsecar ironworks with a considerable number of ironstone 'getters' discharged. There was at least 2,500 dozen (5250 tons) of coal 'in hand' at Elsecar, whilst Joshua Biram suggested making some colliers redundant and transferring them either to Walker's new pit to supply a new furnace or employ them in the construction of a road from Wentworth Woodhouse to the Wakefield turnpike. However, the depression was shortlived for not only did Walker and Co. continue to make plans for a new furnace but by February 1813 Darwin and Co.

had 'blown off' another furnace. The demand for coal had increased so much by December 1814 that Joshua Biram suggested following the lead of other 'Watersale Collieries' by raising the price of Lowwood coal by 1s per dozen and at Elsecar by 1s per waggon.(58) The boom conditions in the local iron industry were reflected in the Elsecar Old Colliery coal sales which rose dramatically from 15941 tons in 1814 to 28161 tons in 1815.

The post war national economic boom was of fleeting duration. For example, the price of Sunderland coal after reaching a cyclical peak of '80s' per chaldron in March 1814 had plummeted by June 1816 to '35.7s' per chaldron.(59) There was a lapse of a year before the depression affected the Elsecar and Milton ironworks since they were not dependent upon government munition contracts that were curtailed in 1815. When the depression eventually arrived it was severe, with no furnaces being worked in 1816/17 at the Elsecar ironworks, whilst at the Milton ironworks one furnace was out of blast for six months during 1817. The slump in the local iron industry was again reflected by a sharp drop in coal sales from the Fitzwilliam collieries with the Elsecar Old Colliery sales falling from 28184 tons in 1816 to 9035 tons in 1817. There was a similar decline in the Lowwood coal sales, but the Elsecar New Colliery was not as adversely affected with its wider and more diverse markets.

The local coal trade slowly emerged from the cyclical trough of 1817/18 until by May 1819 the demand for coke at the Haugh Colliery could be described as good and the sales at Lowwood as 'very good' with boats at Elsecar having to wait between 10 and 14 days to load. This increased activity in coal sales encouraged Fitzwilliam to open the Rainber Park/Brampton Colliery in 1818 and in the following year to purchase the rival Haugh Colliery from Mr Vent whose customers included Swallow at Attercliffe, Booth at Brightside and Walker at Rotherham, all owners of substantial ironworks.

Within two years the Fitzwilliam collieries were again reflecting the national slump in the coal and iron trades with the Elsecar Old Colliery once more experiencing the greatest decline in sales. A shortlived improvement in trade had occurred by 1823 with Hartop and Co. of the Elsecar Ironworks debating whether to set another furnace to work and Joshua Biram opening a third pit that had been idle for several years.(60) This increase in trade was quickly followed by a severe cyclical depression which reached its trough in 1827 and led to the bankruptcy of both the Elsecar and Milton ironworks. Their bankruptcy was potentially catastrophic for the Elsecar collieries who relied so much on their market. It is not surprising that to safeguard sales Fitzwilliam decided to purchase the ironworks. Accordingly the Elsecar ironworks was acquired for £4194-11-0 to be directly managed by the estate for the next 20 years whilst the Milton Ironworks was purchased for £27,000 and leased back to Graham and Co. at 6 per cent interest per annum on the capital.(61)

The danger inherent in over-dependence on a single market was apparent to Fitzwilliam and probably accounts for his strenuous efforts to diversify. An opportunity to find new uses and markets for his coal and the chance of exploiting the high demand and price of tar during the Napoleonic wars, appear to have motivated Fitzwilliam to employ a Mr Parker to erect a tar distillery adjacent to the Elsecar New Colliery. The reduction of tar imports from the Baltic area by the Continental blockade and the increased demand in the shipbuilding industry, promised high returns on any capital invested. This would account for the high salary of £200 per annum paid to Parker in comparison to the basic wage of £150 per annum of the Wentworth House steward. Experiments commenced at Skiers Hall in 1813 and following their success a tar distillery was erected in 1814-15. Some by-products were produced and sold but by January 1818 the works had closed after encountering technical difficulties and mismanagement, although with the termination of hostilities with France in 1815 the domestic market would have again been open to foreign

competition and lower prices.

Another potential market for coal lay in the production of coke. In 1810 experiments were undertaken at the Elsecar New Colliery to ascertain the relative efficiency of burning coal in ovens compared with that in long open fires. The results favoured the oven where one ton of coal produced 10 cwt. of coke in comparison with 8½ cwt. from the long open fire. The Elsecar New Colliery became the largest producer of coke with output in 1811 amounting to 2282 tons. This reached a peak of 3055 tons in 1826.(62) Attempts were made to open up new markets for coke and by 1815 regular shipments were being made as far afield as Wisbech and in 1823 to Malton in North Yorkshire.

Throughout all this the control and regulation of coal prices remained firmly under Fitzwilliam control. More attention had to be given to coal prices after the acquisition and opening of new collieries in the Greasbrough - Rawmarsh area where competition from other proprietors was acute. This was in contrast to the Elsecar collieries where Fitzwilliam held a monopoly of their markets. Following the opening of the Rainber Park colliery in 1818, Fitzwilliam asked Thomas Cooper for a list of coal prices prevailing in competitors collieries. Investigation found that unlike Fitzwilliam's collieries their concerns not only gave additional weight, to encourage sales, but discounts of between 6d and 1s per waggon on cash purchases. According to Cooper this practice gave '... a considerable encouragement to ready money customers', and so Fitzwilliam introduced discounts on cash payments of 6d per waggon at Rainber Park in 1820, 10d at the New Park Gate Colliery in 1823 and 10d per waggon at the Swallowwood Colliery in 1824.(63) No such discounts were thought necessary at the Elsecar and Lowwood collieries where there was little competition.

The lack of a cheap mode of transport for the bulk movement of coal restricted the market of the Rockingham-Fitzwilliam collieries, in general,

to consumers on or adjacent to the Wentworth estate. This applied particularly to the Elsecar, Lowwood and Westwood collieries located some distance from the Don Navigation. In comparison the Basingthorpe Colliery in close proximity to the Navigation was able to be worked on an extensive scale. Prior to 1795 the owners of the Wentworth estate made several attempts with limited success, to widen their coal market. There were schemes to sell coal in London. In addition, there was an attempt to foster an industry based upon coal by-products, such as tar. Finally, subscriptions to turnpike trusts with a further view to widening the market.

The main opportunity to widen and diversify the market for coal came with the construction of a branch of the Dearne and Dove Canal up the Elsecar Valley in 1798. One result of opening the canal was to encourage the sinking of new collieries and the extension of existing mines, for the canal now enabled Fitzwilliam to take advantage of the rapid increase in the demand for coal from the iron industry. As a consequence, coal sales rose from 43,002 tons in 1798 to 123,378 tons in 1828.(64) These figures can be misleading, for they disguise the fact that the opening of the Dearne and Dove Canal had the effect of limiting the sale of coal to one particular type of industrial concern. The establishment of the Elsecar and Milton ironworks tied the Elsecar Old Colliery and to a lesser extent the Elsecar New Colliery, to their market. Even when further collieries were opened nearer the Don Navigation at Rainber Park, Swallowwood and Park Gate their major consumers lay with the ironworks in Rotherham and Sheffield. This reliance on these consumers made the collieries particularly vulnerable to economic fluctuations in the iron industry. It could be argued that whilst canals dramatically raised Fitzwilliam's coal sales, it had the effect of reinforcing the dependence of the collieries on an essentially local market and in particular on one major industrial consumer.

Fitzwilliam fully appreciated the marketing difficulties that faced his collieries. This was reflected in the repeated effort, again largely unsuccessful, to achieve a greater market diversification. Renewed attempts were made to enter the lucrative London market and the production of coal by-products with the setting up of a tar distillery. There still existed the high cost of the movement of coal over long distances that limited the geographical market. This is not to say that coal was not able to be carried greater distances than before the construction of the canal network, as indeed, new markets were opened down the Trent and along the east coast. To some extent these new markets alleviated the effects on the collieries of a depression in the iron industry. Even so, the dependence by the Fitzwilliam collieries on one major market was not overcome until the railways opened up a national market.

CHAPTER SIX

LEASES, MANAGEMENT AND ACCOUNTING

During the eighteenth century, the colliery lease was adapted to meet the economic development of mining. It was the normal practice during the early years of the century on the Devonshire, Portland, Kingston, Newcastle, Norfolk and Rockingham-Fitzwilliam estates to grant leases on fixed rentals irrespective of output, although there were a few exceptions. In 1702, for example, the Duke of Norfolk leased a small colliery on the Whiston estate near Rotherham at 7d per wain load of coal. As output from this colliery was so small and variable, a fixed rental would have proved impractical and uneconomic for the proprietor. By 1737, however, the general situation was changing, with leases containing both fixed rents and royalty payments, although the emphasis still lay on the former. In 1737, for example, John Bowden received a lease to mine Sheffield coal from the Duke of Norfolk at £400 per annum fixed rent, plus one-fifth the value of all coal extracted above this figure.(1)

Any arrangement which encouraged the over-exploitation of the landowners' resources had to be resisted, since it carried with it the danger that the mineral owners' reserves would have been quickly depleted. This was achieved on the Rockingham-Fitzwilliam estate by limiting the number of colliers employed at each colliery, whilst on the Norfolk property the number of shafts allowed to be worked at any one time, was also fixed. In 1737, for example, John Bowden was allowed to work only two pits with a maximum of fifteen 'master getters of coal', with their usual assistants on a fixed rental. On the Wentworth estate, a specific number of colliers were employed at each colliery, with the accounts recording a fixed rental per collier.(2) This fixed rent varied according to the depth and thickness of the coal seam, nearness to market, size of the undertaking, and

sale price related to unit costs. In 1756, for example, John Bowden paid £21-0-0 each for the 12 colliers employed at the Carr House Colliery, whilst Richard Bingley, working the Lowwood Colliery, located at a greater distance from the Don Navigation, was allowed to employ only seven colliers at the lower rent of £17-17-0 per man.(3) Penalties for exceeding the stipulated number of colliers, without permission, could be very severe. When Thomas and James Fenton renewed the lease of the Basingthorpe Colliery in 1799, they had to pay £20-0-0 per day for any collier employed over the maximum allowed of 20, and pay £10-0-0 per waggon over the permissible 18,500 waggons of coal. They were permitted to employ colliers' assistants, however, which included two men for driving the 'endway or carrying on the levels' and another to work the coal for the 'Fire Engine'.(4)

A further disadvantage of a fixed rent and limiting the number of colliers employed was that it prevented the adjustment of output to changing market conditions making it difficult for a proprietor to raise output to meet a rise in demand for coal. To satisfy the rising demand for coal it became customary for landowners, towards the end of the eighteenth century, to calculate rents according to the number of corves or waggons extracted, and by 1800 the base was the acreage which was worked. A fixed rate was agreed on the minimum acreage to be mined each year, with any shortfall made up by any excess in a following year. On the Norfolk and Fitzwilliam estates, the acres worked above the minimum number allowed were usually paid at the same rate. This benefitted the proprietor who could take advantage of a favourable market situation.(5) This method of calculating colliery rents, produced greater flexibility for lessee and lessor with the rapid expansion in the demand for coal during the late eighteenth century, as it allowed lessees to take advantage of a sudden increase in demand whilst at the same time guaranteeing, as far as possible, a minimum income to the lessor. Under a system of royalty payments based on the quantity of waggons extracted, it was difficult for the lessor to keep an accurate check

on the quantity of coal raised. A rate based on acres worked was easier to measure, as each party put forward his estimate, and any disagreement was settled by an agreed arbiter.

The length of leases on the Norfolk and Rockingham-Fitzwilliam estates was usually of 21 years duration. Longer leases with fixed rents could work against the interests of both parties. This can be seen in the case of the Grand Allies (Ravensworth, Strathmore and Wortley) who obtained long leases on extensive tracts of Newcastle coal early in the eighteenth century. When technological innovations allowed the establishment of large collieries in the Wear area they were left with mineral assets declining in value. Conversely, the lessor could suffer from the inability to re-negotiate leases during a period of rising coal prices. In such circumstances the advantage of a favourable market was enjoyed solely by the colliery proprietor. Even those leases taken over 21 years could experience a considerable rise in coal prices.(6)

The initial years of a new colliery could see a considerable capital investment in pits, soughs, waggon-ways, pumping engines and steam whimseys. To overcome periods of low sales and profits, many lessors gave concessions to assist the proprietor. In 1801, for instance, the Killingworth Colliery was freed from royalties during its first three years of working. Likewise, in 1750, the Marquis of Rockingham allowed Richard Bingley to work the Elsecar Colliery rent free for two years in return for repairing the sough that ran from Elsecar Green to the 'great Arm-royd'. Any failure to comply with this arrangement would have involved a fine of £200. When William and Thomas Fenton undertook to sink the Basingthorpe Colliery in 1758, they paid a reduced annual rental of £324-0-0 for the first two years and £648-0-0 for the remaining 19 years of their lease.(7) The annual rental and royalties paid by a colliery proprietor were carefully calculated to ensure a fair return for both parties and detailed calculations were carried out by the

Norfolk and Rockingham-Fitzwilliam estates before a lease was granted. These entailed estimated revenue from coal sales and the costs of production, with the latter item broken down into wages paid to employees, working materials, interest and capital expenditure per annum. Such calculations determined the viability of the undertaking for a proprietor and revenue to the landowner.(8)

The South Yorkshire landowners and colliery proprietors were fortunate in having few wayleaves to pay, due to the consolidated nature of the great landed estates. This not only facilitated the movement of coal, but kept down the costs of production. In the Great Northern Coalfield, wayleaves could be a considerable burden, involving payments sometimes as high as the royalties and those landowners who owned land between the collieries and the shipping points, were able to make fortunes. The wayleave over Whickam Moor for example, returned £3,000-0-0 in 1739.(9) The Norfolk and Rockingham-Fitzwilliam collieries were not so encumbered, and their leases merely contained clauses giving the proprietors permission to construct a road or waggonway over tenant farms, provided they paid adequate compensation.

In granting colliery leases, the landowner sought, as far as possible, to protect the long term value of his estate by ensuring the lessees kept the collieries in good condition and did not hinder the other economic activities of the owner. Attempts were made to safeguard mineral resources, agricultural land values and the general appearance of their property, by insisting that the lessees filled in and levelled old pits, kept the levels in good order, lined soughs, paid any damages to tenants and returned the soil to an arable condition. The instructions concerning the method or technique of working the Norfolk and Rockingham-Fitzwilliam collieries, were usually vague; it was stated that they should be carried on in a 'workmanlike manner'. Such imprecise clauses were seriously to jeopardise the viability and revenue of the Norfolk collieries after 1805. What was quite

specific in a number of leases, however, was that the landowner used the lease as a means to protect his coal market.

As part of a lease in 1763 granted to Booth & Co. for an ironworks, they were obliged to purchase coal from the Duke of Norfolk if he opened a colliery nearby, and in 1786, on Richard Swallow's renewal of the Chapeltown Colliery lease, he agreed to respect the Norfolk coal monopoly by refraining from the sale of coal to consumers, except for the £60 of sleck allowed for the nearby nailers.(10) Earl Fitzwilliam, in allowing Darwin & Co. to erect the Elsecar ironworks, stipulated that they had to purchase his coal if there was a colliery within a mile of the works.(11) The lessees in return, were allowed to sink all necessary shafts, erect pumping and winding engines, drive soughs, extract clay for brick making and construct roads and waggon-ways.

The nature and intention of a colliery lease was to strike a balance between protecting the landowners' estate and mineral revenue, and providing a sufficient profit to the proprietor, The inability of some leases to attain this balance is shown in the experience of the Duke of Norfolk. In 1774 Townsend and Furniss, proprietors of the Sheffield collieries, expended some £3,280 in the construction of a waggon-way from the Wood Pits into the town but as a consequence of the reduced cost of transport afforded by the waggon-way, Norfolk raised the colliery rent. The increased rent was adversely to affect the profitability of the pits. This became clear in 1779, when a report commented that: '... the Rent being something advanced to his Grace, left a little profit to the undertakers but not sufficient encouragement after sinking such a sum.'(12) The profitability of the collieries was further reduced, for not only had the interest and capital on the loan for construction of the waggon-way to be repaid, but geological and marketing difficulties were also encountered. These difficulties included geological faulting, an increased proportion of small to hard coal and a

greater depth of working and distance from the town. These problems had turned the collieries into a loss-making concern by 1781, and it was in such circumstances that the lessees surrendered their lease.

By contrast the consequences of a lenient lease can be seen when the Sheffield Ponds, Crooks Croft and Handsworth collieries were sub-let in 1805 to the consortium of Sheffield businessmen. In order to encourage the purchase for £72,500, of the Norfolk and Eyre interest in the collieries, the rental was reduced to £750 per annum for 18 acres of coal. The lease also allowed the proprietors to keep the colliery equipment on site for up to 12 months after expiration of the lease, whilst there were no detailed clauses referring to the working of the mines, except that the collieries should be carried out in a 'workmanlike manner'. The consequence of such a favourable lease enabled the lessees to abandon the largest colliery at Crooks Croft and remove the equipment to a part of the estate where the coal could be more easily extracted. No proper plans were kept of the works which not only prevented an accurate calculation and record of the coal mined, but also promised to produce difficulties for the future exploitation of the coal. In 1817 at the Handsworth Colliery, the same consortium intended leaving the coal on the deep of a fault, and in 1820 a blocked water course threatened to jeopardise work on the remaining 18-20 acres of coal left in the mine. In addition, the lease did not prevent the deliberate running down of the capital equipment. By 1820 Sorby & Co. had buildings valued at £397-0-0 demolished, sold a brick kiln to Huntsman at £20, partly pulled down an engine house at £400, sold 2 houses which were later demolished at £20, whilst a Mr Swinnerton claimed property at £165. Out of a total valuation of the buildings in April 1820 of £1,548-10-0, the lessees had destroyed, sold or had claims upon property of £982-0-0. The value of the colliery buildings and equipment declined from £16,515-7-3½ in 1805 to £9,297-8-4½ in 1820.[13] Not only was there no clause to prevent the run-down in capital stock but the lease was devoid of conditions on how the

collieries were to be left, and thus by 1820 the consortium had almost worked out the Woodthorpe Colliery and new winnings were needed at the Sheffield, Manor, and Handsworth collieries, involving an expenditure of £18,000. As a consequence, the lease granted in 1820 took into account the vast amount of capital needed to carry on the collieries. It was in the light of such developments that in 1818, James Losh of Newcastle commented on the 1805 colliery lease:

> 'Having answered these queries I cannot keep observing that the great value of the stock upon the premises at the time when they were let the smallness of the Rent reserved & other Circumstances make it no easy matter to Account for granting a Lease so highly advantageous to the Lessees and Consequently so injurious to the Lessor or those who were to be his successors.'(14)

Although Norfolk seriously considered taking the lessees to court, Counsel suggested coming to an agreement with the proprietors as the most appropriate form of action.

In the lease granted to Holy & Co. for 21 years from 1820, Norfolk tried to prevent an occurrence of the malpractices of the previous lessees. The lessees were allowed the usual freedom to make shafts and soughs, erect houses, pumping and winding engines with space to make and store coal, coke, timber and bricks, but the rent was considerably increased with more specific clauses on the working of the collieries. The annual rental was £2,800 for 7 acres of the Sheffield Bed, £1,200 for 6 acres of the Sheffield Manor Bed and £500 for 5 acres of the Handsworth Bed, whether the coal was worked or not. Any deficiency could be made up during the following year, but the Duke's permission was to be obtained before they could take the coal from another bed. The lease placed greater emphasis on keeping in good repair soughs, levels and working places and the lessees were to: '... maintain and support proper and sufficient pillars posts and windgates according to

the best rules of working Coal Mines in the County of York.' The soughs and 'level heads' were to be kept at their own expense: '... clear upstanding and in good condition well timbered and ventilated, and clear of water and foul air and so leave the same at the end of the said term ...' Ribs of coal of the 'usual thickness', according to the direction of the Duke and his agent, were to be left between the 'Level Heads' and the works of the collieries, to preserve the 'Water and Air Levels'. Barriers of at least 30 yards thickness had to be left between the Duke's land and any other colliery, whilst all pits were to be walled, timbered, bricked, or stoned if they were required to be left open.

To prevent the collieries being left exhausted at the end of the lease, each pit, with the exception of Handsworth, was to leave sufficient coal for at least two years working and no buildings could be demolished without the permission of the Duke. As surety that the lessees intended to invest large capital sums in working the coal, the lease demanded that on or before 25 March 1822, the lessees either made a new 'winning' of the Sheffield Manor Bed at a place acceptable to the Norfolk estate, or expended at least £8,000 in the attempt. In addition a further colliery was to be sunk in the Sheffield Bed if there were not more than 40 acres of coal left on the deep of the present mine and if by March 1822 this had not been done, at least £10,000 should have been spent in the attempt.

As acknowledgement of the increasing threat to his Sheffield coal monopoly, Norfolk agreed in the lease to oppose the construction of a railway or road through his estate, which may have assisted the carriage of competitors' coal. Furthermore, if any application were made to parliament relating to the Sheffield Park turnpike road or any other road to take its place, the Duke, on request from Holy & Co. was to: '... use his utmost interest Influence and assistance in endeavournment to continue the present exemption from payment of Tolls in respect of coals and cokes conveyed from

the said coal mines and collieries ...'(15)

Management of the Norfolk Collieries

Coal mining was one of the first industries to develop the techniques of modern management practice with the lead taken by the Northumberland and Durham coalfield. This was as a consequence of the problems created by drainage, ventilation, haulage, marketing and an expanding labour force. As a result of these there was a need to employ the skills of managers, viewers, and mining consultants. Their expertise and responsibilities not only included the management of collieries on the great landed estates or groups of lesser landowners but the arrangement of leases and the submission of reports.(16)

During the eighteenth century many viewers from the 'Great Northern Coalfield' moved to other coalfields taking with them their mining expertise. Curr, for example, superintendent of the Norfolk collieries between 1781 and 1801, received his training in the Durham coalfield, whilst his successor Nixon came from Newcastle. The movement of mining consultants and viewers between the coalfields assisted in the spread of technological innovations and improved management practice. This was also assisted by the numerous mining manuals which were published, such as the one introduced by Curr in 1797 entitled 'The Coal Viewer and Engine Builder's Practical Companion'. Not all the major mining areas could boast of the necessary skilled personnel. In the Staffordshire coalfield there was a shortage of educated and trained men in the principles of mine engineering, and according to Machin some Yorkshire officials were unable to read maps and regulations, and also lacked an adequate technical knowledge.(17) Even where the necessary expertise was available the manager sometimes had too many responsibilities to be able to carry out his duties with any real degree of efficiency. This was also true of some great landed estates where non-mining activities intruded upon colliery management. On the Wentworth estate, for example, the house-

hold steward was responsible for both the collieries and the management of Wentworth Woodhouse. As a result he was concerned with such diverse activities as sinking a new pit and the carriage of pineapples to Milton.

As collieries became technologically more advanced many landed proprietors, due to their inadequate technical knowledge, were increasingly compelled to rely on the specialist skills of viewers and agents. A case in point was the Earl of Scarbrough, who during the late eighteenth century came to rely almost entirely on the expertise of William Stobart, his Lumley estate viewer. The landed proprietor was not completely at the mercy of their viewer, for not only could the landowner call on the opinion of outside mining consultants and his land agent but the viewer relied on the proprietor for his reputation and future employment. On the Sheffield estate Norfolk called on the services of the mining consultants John Stephenson and the renowned John Buddle, senior.(18)

John Curr was originally employed as a viewer to the Norfolk collieries under lease to Townsend and Furniss and whilst there may be some doubt on when he was appointed, his employment can be traced from at least 20 December 1777 when his name first appears in the estate account books. After the collieries were taken under direct management in 1781 Curr continued in employment until 1801 as the 'Superintendent of the coalworks of his Grace Duke of Norfolk.'(19) The 'Superintendent's' responsibilities were both numerous and varied. They covered ventilation, drainage, haulage, pit sinking, the opening of new collieries, sales, the employment and supervision of workers and the keeping of accounts. In addition Curr was expected to solve any technical difficulties which were encountered and to introduce the necessary innovations to facilitate the efficient extraction of coal. Although Curr was able to give his full attention to the management of the Norfolk collieries the varied nature of these responsibilities almost certainly worked against managerial efficiency. Not only did he have to look

after the day to day running of the collieries but he bore the full burden of profit creation and supervising the huge capital investment. He took the full responsibility for any inadequate return on capital as was seen by his dismissal after 20 years service in the Norfolk collieries:

> 'In answer to your letter of expostulation on being dismissed from the management of my collieries in this neighbourhood I have to say that the want of success in concerns so important to myself & the trade of Sheffield, has appeared to me a sufficient reason for placing the management of them in other hands, to try whether different measures may not produce better consequences.'(20)

Colliery viewers and agents were particularly concerned with protecting their reputation, which in itself could be a spur to efficient management. When Curr was dismissed, his major concern was whether it would reflect on his character and integrity. In order to satisfy Curr on these points, Norfolk wrote, that it was a reflection of his judgment not integrity, and that it was his duty as owner to try new management. Norfolk went on to say that his dismissal was not due to any personal dislike, and that he would appreciate any advice Curr may like to profer in the future.(21)

Whilst the managerial ability of Curr may be questioned his engineering expertise was never challenged, even following several reports made on the collieries by John Buddle. In a report of 1787, Buddle referred to Curr's innovations as containing considerable merit, with the pits on the 'Deep Side' at Sheffield Park Colliery being carried on in a 'very fair and regular manner' with the leading barrow-gates, drifts and openings 'in the most judicious state of Advance for the effectual Getting of the Coal.' On the method of raising corves by conductors and landing them with the aid of tiplers, Buddle commented that they were based on 'true mechanical Principles' which should have the desired effect. He recommended that the innovations be introduced immediately to overcome any unforeseen eventualities or possible 'obstinacy of workmen.' Thus, one of the foremost colliery consult-

ants was impressed with Curr's technical ability. Even in 1789, when the newly opened Attercliffe Colliery was encountering serious drainage difficulties and competition from the Sheffield Park Colliery, Stephenson, who was brought in with Buddle to view the mine, remarked that the reason for the colliery not working to expectation could not by any human prudence or foresight have been prevented.'(22) On the great landed estates, where the landowner was unable to supervise closely their colliery managers and where control was usually exercised from a distance, the employment of honest and trustworthy officials was of paramount importance as there were many opportunities in such circumstances, for embezzlement, fraud and general mismanagement. For example, at the Whitehaven Colliery, owned by the Lowther family, there was considerable dishonesty and indiscipline due mainly to the incompetence of the manager who neglected his work for liquor, until he was replaced in 1802.(23) Earl Fitzwilliam also suffered from mismanagement at both the Elsecar Ironworks and the Tar Distillery. Therefore once a manager was found with the necessary personal and professional qualities other members of the family were usually employed, producing dynasties of land agents and viewers. The Eyre family provided several generations of land agents to the Norfolks whilst George and William Curr were employed alongside John Curr in the Norfolk collieries.

In order to reduce further the possibility of malpractice, a system of checks was usually introduced. For example, the Sheffield colliery accounts kept by John Curr were examined by Henry Howard the father of the 10th Duke of Norfolk until his death in 1787 and in addition to reports made by outside consultants Curr had to submit reports to Lord Surrey and Vincent Eyre, the land agent. Eyre who was the direct representative of Lord Surrey and the Duke of Norfolk held overall responsibility for the collieries and in times of difficulty it was common for landowners to turn to their land agents for advice. The direct involvement by Eyre in the collieries increased after 1787 following his partnership with Norfolk and

investment totalling several thousand pounds.

As superintendent of all the Norfolk collieries, Curr was particularly in a position of trust, especially from 1792 when he established his own iron foundry. This position could easily have been abused for the majority of iron purchases by the collieries came from Curr's foundry which amounted to £14,069-0-0 between 1792 and 1801.(24) However, there was an advantage in this situation for it facilitated the ease by which Curr could devise and construct innovations for the collieries. As superintendent of the Norfolk collieries Curr received an income of £190 per annum which consisted of £100 for the Sheffield and Manor Colliery, £70 for the Attercliffe Colliery and £20 for the Hesley Colliery with a further £25 as payment for viewing and measuring the coal and ironstone mines under lease. The iron foundry provided an alternative source of income along with the manufacture and sale of flat ropes and royalties on his numerous other patents. His invention of conductors and tiplers for landing the corves were adopted in many collieries and Curr accepted that: 'I have received something handsome for the Patent Rights from sundry Proprietors of Collieries ...'(25) Curr did not feel satisfied with his salary for superintending the Norfolk collieries when his responsibilities and the expenses that had to be paid from income were taken into consideration. This was brought out in a letter Curr wrote to Norfolk in 1801:

> 'If I had charged a less price some years back for my good & taken the same pains in manufacturing them as I have done, I must have made a forfeit of as much if not more than the salary I received for my Agency to the Collieries; having for all my trouble and Inventions, and including the Risque of Moneys deposited in my hands no more than £190 per annum; and when I have deducted an assistant Clerks salary, whom I was obliged to keep, the keep of only ½ my Riding Horse, House Tax, Coals, Candles for Office, and a sufficient Agents House to live in, all of which are in general found by proprietors of collerys; I

have not pocketed towards the maintenance of myself and family more than £80 or £90 per annum.'(26)

Certainly his salary appears small when compared to the £100 per annum received in 1786 by William Budle the cashier and superintendent to the Lumley Colliery of the Earl of Scarbrough. The Lumley Colliery was a small undertaking in relation to the Sheffield and Manor Colliery. In 1786 the coal sales of the former amounted respectively to £904 and £8144-1-7 in the case of the latter. In addition, Curr managed the Attercliffe and Hesley collieries. A comparison of salaries between colliery managers is difficult to assess as conditions of service varied. On the Wentworth estate the collieries were supervised by the Household steward who in 1787 was paid a salary of £100 for all his duties. Even with a dramatic rise in coal output with the opening of a large colliery at Elsecar in 1793 and Parkgate in 1823, the Wentworth steward received only £150 per annum. However, this salary was supplemented by annual gifts that increased from £100 to £400 although it was not until 1830 that a rise in the basic salary was made.(27)

The lack of documentary evidence prevents a detailed analysis of the management structure of the Norfolk collieries. Furthermore, it does not allow an assessment of Norfolk involvement and control over their enterprise. Independent reports were called for by the Norfolk family, especially before any large investments were carried out or when serious difficulties were encountered in the collieries. The final decision relating to policy would have been made by Lord Surrey and the trustees prior to 1786, and afterwards by the Duke of Norfolk. Once Vincent Eyre was taken into partnership the enterprise was probably left under his general supervision. Whilst John Curr was directly responsible to Eyre and Norfolk, he does appear to have had considerable freedom to manage the collieries and introduce his innovations. Each colliery was put under the charge of an agent with an underground agent to supervise the work below ground.(28)

There appears to have been a reorganisation of management responsibilities following the dismissal of Curr in 1801, and the engagement of Charles Nixon as superintendent on a reduced salary of £100. In 1805 Nixon joined with a consortium of Sheffield businessmen to lease the collieries but probably continued with his previous responsibilities as a working director. When Norfolk divested direct control of the collieries more reliance had to be placed on mining reports from independent viewers. Accordingly in 1813 William Locke was employed as 'Surveyor of the Duke of Norfolk's mines and minerals in the West Riding'. He was required to report on them at least twice a year. For this he received a salary of £42 per annum. Later in 1817 William Stobart was employed to submit a comprehensive report on the condition of the collieries.(29)

Management of the Rockingham-Fitzwilliam Collieries

Both Rockingham and Fitzwilliam were directly involved in the management and decision making process in their collieries. No decision concerning the opening of new pits, extension of workings, wages and prices, could be taken without the landowner's prior consent and their participation in managerial decisions increased as the estate's minerals were exploited on a larger scale. This can be seen in the correspondence on colliery matters between Fitzwilliam, his land agent and his house steward. According to Mee the collieries were rarely mentioned in correspondence with the house steward prior to 1806 which in Mee's view reflected Fitzwilliam's lack of interest and expertise.(30) But this argument cannot be sustained, since the Wentworth estate had been in Fitzwilliam's possession for some 24 years by 1806. This was a sufficient period of time to acquire the necessary knowledge to manage the collieries effectively. Furthermore, Fitzwilliam cannot be accused of a lack of interest in the exploitation of his minerals following the capital investment in opening the Elsecar New Colliery in 1793 and the extension of the Elsecar Old and Lowwood collieries between

1793 and 1807. The reason for the greater involvement by Fitzwilliam in the estate's minerals was the proposed construction of the Dearne and Dove Canal whose promised reduction in transport costs would enable coal to be worked on a more extensive scale. The interest and involvement by Fitzwilliam increased in proportion to the level of exploitation and capital investment in his coal resources. Prior to 1795 few references were made to the collieries in the Rockingham-Fitzwilliam correspondence which reflects not a lack of interest in their management but the minor role then played in estate activities. It is not surprising therefore that with considerable investment in the collieries more interest was taken in matters relating to drainage, prices, competition, wages and management that directly affected the return on capital.

The inability of Rockingham and Fitzwilliam to closely supervise the day to day working of their collieries, due to their other estate activities and political responsibilities, made them particularly concerned to obtain the services of honest and capable agents to avoid, where possible, fraud, embezzlement, and managerial incompetence. Although Fitzwilliam had capable managers he was reluctant to delegate responsibility. Instead he sought to control or influence such details as the location of a new pit or the driving of soughs. The insistence of a landowner that his sanction was necessary even on matters which could have been left to the manager, was an inefficient method of decision making. Once honest, trustworthy and competent managers were acquired, then it was common for other members of their families to be employed. This practice of nepotism had the advantage of facilitating the transference of skills and knowledge from one generation to another, rather than the landowner relying on outside experts who were not only unfamiliar with working practises on the estate but whose personal qualities were unknown. On the Wentworth estate the position of house steward passed from Benjamin Hall to his nephew Joshua Biram who in turn was succeeded by his son Benjamin Biram, whilst the Hague and Cooper families provided several gen-

erations of colliery managers.

As expenditure in the collieries increased Fitzwilliam was conscious of the need to keep a more rigid check on financial management which reinforced his reluctance to delegate managerial responsibility. This was achieved by limiting those decisions directly concerned with expenditure to the land agent and house steward with Fitzwilliam holding overall authority. In spite of Fitzwilliam's efforts to control the management and working of his collieries the increased technical complexity of mining meant that he had to rely upon his land agent and steward. Even in this area of management he questioned his agent's judgement although usually he had to concede the final decision on technical matters to Joshua Biram. This was indicated in 1809 when a decision was required on whether to pump water 3 yards out of the Lowwood Colliery to an old level or 36 yards to the Elsecar level. Whilst enquiring about the suggestion of raising water 36 yards to the Elsecar level, Fitzwilliam concluded his letter to Biram by stating '... I know you have considered well this subject, and your opinion is better than mine.'(31)

Joshua Biram served a long apprenticeship as clerk to his uncle Benjamin Hall to whose position as house steward he later succeeded. Although Biram did not have the same expertise or innovating genius as John Curr, his knowledge developed along with the expansion of the collieries, whilst specialist advice was always available from mining consultants and the example set by the more technological advanced Norfolk collieries. Indeed the services of John Woodhouse of Chesterfield were sought on several occasions on drainage and pumping engines. However, Joshua Biram became sufficiently competent for other landowners such as Lord Manvers in 1809 to seek his advice. He also acted as an arbiter in the Silkstone Common coal dispute in 1823-4.(31a)

By December 1829 Lord Milton was taking a more active role in decision making although overall control was still exercised by Fitzwilliam. Viscount Milton's technical competence was superior to his father's. This was revealed by Milton warning Benjamin Biram, who was now more involved in management, not to hurry into the London market by asking for plans showing the working of the Swallowwood coal and by carrying on a lengthy correspondence with Biram on the technical merits of various rail designs for the proposed Swallowwood Colliery.(32)

The basic structure of the management changed as the collieries developed, to produce a greater role specialisation and re-allocation of responsibilities. When the Marquis of Rockingham took the Elsecar Colliery 'in hand' in 1752 he employed Thomas Smith as manager on a salary of £20-0-0 per annum, with Joseph Hague as assistant. The duties of Smith included overseeing the works, keeping the accounts, sales, debt collecting and sending regular fortnightly reports to Rockingham. By 1772 Joseph Hague managed the Elsecar Colliery with title of overseer, whilst Michael Bisby performed a similar function at the Lowwood Colliery. The mines were so small that the managerial functions could be carried out by the overseers under supervision of the house steward and land agent, who in turn were directly responsible to Rockingham.

The eighteenth century land agent held considerable influence over the landed proprietors' collieries, and it was to them that the landowner turned when any serious difficulties arose. However, their role gradually reverted to one of financial control as colliery management became more complex. This situation can be seen on the Wentworth estate where, prior to 1800, the land agent and solicitor Charles Bowns took a detailed interest in the collieries by corresponding with the house steward and Fitzwilliam on such diverse matters as drainage, labour and the accounts. After 1800 Bowns specialised in auditing the accounts, checking on coal prices and arranging

leases, in addition to his other estate duties. Indeed, his range of duties were so wide that no detailed control could have been exercised with the growing complexity of colliery management. In a letter written to Fitzwilliam in 1797 Bowns refers to his responsibilities as a land agent - solicitor. When asking for a rise in his £400 annual salary, Bowns stated that in addition to auditing the accounts of Colonel Beaument of Bretton Hall and Mr Fullerton, he collected rents from 867 tenants, cared for 17,522 acres of land, with farm rents of £28,000 and £12,000 from mines, canals, woods and tithes for Earl Fitzwilliam. There were also the Fitzwilliam estates in Ireland, Malton, Higham Ferrers and Harrowden to be audited. As a consequence Bowns complained that he was unable, without more assistance, to spend as much time as he wished on Fitzwilliam's affairs. The matter was referred to a Mr Baldwin who after consulting 'Masters in Chancery' suggested a salary of £1,200 per annum, a sum that was duly paid.(33)

Whilst Fitzwilliam took a personal interest in the welfare of his employees, he neglected the salaries of the senior estate management but rather left it to the manager to bring any complaint to his attention. The managers were reluctant to ask for a rise in salary until necessity demanded action and there is evidence, especially in the case of Bowns, that an insufficient salary impinged on the efficiency of estate management. In 1831 Benjamin Biram requested a rise in salary for Joshua and himself and in so doing compared the income and responsibilities of his father with that of the jockey employed by the estate who rode about a dozen races a year. Benjamin commented that Joshua's wages were '... inadequate for the confidential situation which he holds, and by no means proportionate to the duties he has to perform.'(34) Although Joshua received a salary of £150 per annum and Benjamin as clerk £50, they were also given gifts that had risen over the years from £100 to £400, but none had been granted since 1828. Both were successful in gaining a rise in salaries following their protest. Fitzwilliam was either unaware of the different system of wage

bargaining between employer and employee that had developed through industrialisation or was unwilling to conform to the new practices. The provision of gifts to supplement income was symptomatic of a paternalist who paid an increase in salary according to whim rather than resorting to wage bargaining or equating income to responsibilities.

On the retirement of Michael Bisby, overlooker of the Lowwood Colliery, in January 1794, Joseph Hague assumed the position at £50 per annum along with the additional responsibilities for keeping the accounts of all the Fitzwilliam collieries. These accounts were checked by the house steward, audited by the land agent and then sent to Fitzwilliam. The aim of this system of checks was to reduce the risk of embezzlement and mismanagement. Another method of protecting the concerns was to place in positions of responsibility members of families with proven honesty and conscientiousness. In 1795 for example, the Hague family provided the overlookers at all the Fitzwilliam collieries.(35)

The resignation of Michael Hague, overlooker at the Elsecar Old Colliery and the men under him in December 1797, prompted a reorganisation of the management structure. The plan accepted was that put forward by the land agent Charles Bowns and for the first time a 'Banksman' was appointed at each pit with responsibility to record the output of coal. Thomas Cooper was promoted to 'underground superintendent' and Joseph Hague was to take the position of 'General Inspector of all the Collieries', to receive the accounts from the banksmen, make contracts, pay wages and 'regulate' from time to time with the workmen. Benjamin Hall, the house steward, suggested that banksmen at Lowwood should receive a wage of 15s and at Elsecar 12s per week and the 'underground agent' should be paid 15s per week.(36) It can be seen that even as late as 1797 the land agent had considerable influence over major policy decisions concerning the Fitzwilliam collieries. This substantial reorganisation of the management structure with its devolution

of responsibilities and specialisation of roles reflected the increased burdens placed on the personnel by an expansion in the mines.

A further consequence of the increased scale of mining on the Wentworth estate was the employment in 1793 of John Deakin for '... inspecting and directing the working and management of the Collieries ...'[37] for which he received a salary of £63 per annum. Deakin was employed to supervise the sinking of the Elsecar New Colliery and in this and other duties he was assisted by Michael Hague until 1797. These duties included the supervision of the day to day work of the collieries with control over the overlookers. He was directly responsible to the house steward from whom he received his instructions whilst the house steward in turn sent reports to the land agent and Fitzwilliam.

The death of Deakin in 1802 gave an opportunity for a further reorganisation with John Bennett being made responsible for the 'superintendence and keeping the accounts' and assuming with the underground stewards some of the duties of the overlookers. Bennett had worked for 10 years at the Darnall Colliery of Deakin and Co. but appears to have left when the Duke of Norfolk acquired the mine in 1798. Almost certainly he would have introduced the practices and methods employed in the more technologically advanced Sheffield collieries. The land agent's position had by this time become one of financial control with the day to day management of the collieries falling to the house steward and superintendent, both of whom reported directly to Fitzwilliam over all other aspects of management.

This hierarchical system of management was designed to limit policy making and control over expenditure into as few a hands as possible. By 1804 decisions relating to expenditure were controlled directly by Fitzwilliam through the house steward Joshua Biram, although advice would be sought from the land agent. The unwillingness of Fitzwilliam to delegate responsibility threw a considerable burden onto the house steward who had

other estate duties to perform. This system would have prevented the house steward having detailed control or expertise over every aspect of management. The lack of managerial specialisation almost certainly produced inefficiency in an expanding business organisation. Indeed Bowns was to complain to Fitzwilliam on several occasions after 1830 of the need to have more strict economies to prevent unnecessary expenditure.(38) It was not until 1833 that the house steward's duties were separated from the management of the collieries, this latter position being filled by Benjamin Biram. Even so, with the increasing complexity of colliery management no further delegation on any major scale was introduced before 1850.

Method of Accounting

The Norfolk Collieries

On the landed estate the steward was generally accepted as holding a superior position to that of colliery manager, and as a consequence the colliery accounts were usually calculated in the same manner as the general estate accounts. The accounts of the Norfolk collieries between 1781 and 1805 were typical in being based on the 'master and steward system', with double-entry book keeping. The accounts show a 'credit' side indicating expenditure and a 'discharge' side for income. Its main advantage lay in providing the landowner with a relatively easy check on the financial position of the undertaking and in providing a guard against embezzlement by employees.(39) In addition, the landowner was able to see total income and expenditure and the financial situation of the collieries at any time. After the dismissal of John Curr in 1801, following an acute financial crisis, the accounts were balanced several times a year instead of on the basis of the usual annual audit. This enabled Norfolk to keep a constant check on the 'profitability' of his mining enterprise.

The Norfolk collieries between 1781 and 1801 kept a Bill Book to record all weekly expenditures. In addition weekly accounts recorded the coal extracted and sold, with income and expenditure divided into 'credit and discharge' accounts. These accounts were transferred to an annual account book that gave aggregate weekly income and expenditure which in turn were totalled to give an annual balance. The colliery balances, the difference between total annual income and expenditure, were broken down into wood used from the estate, rent that would have been received if the collieries were leased, and profit and interest on monies expended. This last item was seen by Norfolk as the true profit or return for managing the collieries, for it showed what he had received above that of a lessor. Whilst this enabled Norfolk to see the difference between total revenue and expenditure it did not show the rate of return on capital invested and may have led to over-investment. The current and capital items of account were calculated together, although expenditure for sinking a new shaft was sometimes taken out of the accounts but otherwise there was no distinction between the two. This was not important as long as the collieries remained small, and their capital expenditure limited. In such circumstances any distortion of profit was kept to a minimum but this was not the case in large scale collieries where considerable expenditure was required on maintenance or installation of capital equipment.(40)

After Norfolk went into partnership with Vincent Eyre an attempt was made to produce a capital account, as the capital costs of the enterprise were to be shared equally between the partners. Thus the sinking of new pits at the Attercliffe and Manor collieries were entered into a separate account. Expenditure on new pits and equipment were calculated initially in the current account and deducted at the end of each year. However, other capital items on wood and corves that were added to stock following an extension of the underground workings, were not kept separately from current expenditure on maintenance.

Whether the Norfolks directly managed or leased their collieries detailed estimates of running costs including wages, capital expenditure and potential revenue, were called for to calculate rent and profit. In 1787 for example, John Buddle was employed to produce a detailed estimate of the cost of sinking a new colliery on Attercliffe Common with the possible returns on the capital invested. Buddle used a not generally accepted practice for the late eighteenth century, by taking into account capital depreciation in the calculation of profits for the Norfolk collieries. At the Sheffield Colliery in 1784, a figure of £125 per annum was taken for the reduction of 'sums sunk' and the wear and tear on materials.(41) Apart from the colliery reports no account was taken of capital depreciation, indeed the value of the fixed capital stock at any one time was calculated by reducing the materials to their value per weight of timber or iron which reflected the initial capital investment rather than their working value.

The Rockingham-Fitzwilliam Collieries

In common with the Norfolk collieries those on the Wentworth estate were based on double-entry book keeping with receipts placed on the credit or 'discharge' side and payments on the debit or 'charge' side. Prior to 1793 the current and capital expenditures were calculated together but this was of little consequence when the capital investment remained small. Following the large capital sums invested in the Fitzwilliam collieries from 1793, some attempt was made to differentiate between current expenditure or running costs and capital items of account, by the introduction of an 'Expences' account. The ordinary or current accounts were kept by each colliery manager who entered all receipts for coal sold, arrears, wages and 'incidental' payments.(42) Even so, the 'Expences' account was not entirely a capital account for it recorded not only capital items, but also current expenses, such as allowances to widows and colliers. Furthermore it is not possible to differentiate between items that added to the capital stock and

those used for general repairs, on whether expenditure on iron rails and props were for maintenance or extension of the workings. However, over the period of this study, as many of the collieries were newly opened or extended, the bulk of the expenditure would have been on capital equipment.

A new departure was seen with the sinking of the Rainber Park Colliery in 1818, in the 'Capital expended' entry in the 'Expence' account.(43) Here the Earl charged himself interest of between 4 and 5 per cent on the money expended in the collieries and transferred this to the estate account. In effect the 'Capital' was deemed to be every expense incurred on behalf of the colliery as shown in the Household General Account, that is, all 'extraordinary' expenses.(44) There was a considerable element of capital expenditure included within the 'Capital Expended' entry in the accounts, especially during the early working years of a colliery when replacement expenses would be at a minimum. However, these figures do not give a reliable view on profitability, efficiency or rate of return on investment as some current expenditure was included, such as allowances to workers, whilst over a period of time replacement costs would rise and there was no differentiation between these and additions to capital stock. After the opening of a colliery capital expenditure fluctuated according to market conditions with investment rising with the demand for coal. In the Rainber Park Colliery the 'capital expended' item rose steadily until 1822 and remained constant until 1826 when there was a considerable expenditure on colliers' cottages.(45)

The colliery 'balance' was the difference between total revenue and everyday working expenditure. This also included payment of the previous year's outstanding debts which were recorded on the credit side with the debts at the end of the year placed on the debit side. Until 1806 profits were calculated by subtracting the cash received from the previous year's outstanding debts, with the difference added to the balance. The 'Expences' account was kept separate from the colliery balances. The expenses were

recorded directly into the Household General Accounts. In the 'Household Accounts' the individual colliery balances are referred to as their profits. However, in another source all the colliery balances are added together, for each year, and the sum of their 'expences' deducted, with the resulting figures referred to as profit or net profit. This latter practice commenced in 1807, to give two definitions of profits, one for each colliery and another for the whole mining enterprise. The 1807 method did give Fitzwilliam an overall view of the profitability of his collieries based on the difference between total incoming and outgoing items of account. This system did give Fitzwilliam some appreciation of the financial position of his collieries and allowed the close observation of all expenditures.

Unlike many early nineteenth century collieries, those worked by Norfolk and Fitzwilliam did make an attempt at keeping a capital account, but even so, except when estimates of profits were calculated, no account was taken of capital depreciation in the accounts. During periods of high capital investment this could seriously distort the colliery profits when these were added to current expenditure. Although the Norfolk and Rockingham -Fitzwilliam families attempted to adapt their accounting methods to the demands of their large industrial undertakings, they were tied too closely to the established system of land management and auditing, which were not conducive to efficient industrial organisation. The system did not allow the true calculation of profit or the rate of return on capital invested, and as a consequence, it was relatively easy to over-invest, as probably was the case with the Norfolk collieries between 1781 and 1801. This tends to be borne out after 1805 when the lessees were able to raise output significantly with less capital equipment. The inadequacy of the accounts reflect

the limitation in accounting at this time which make it difficult to extract any useful information. Indeed, the landed proprietor was in the position of a pioneer in the introduction of modern management and accounting techniques. It can be seen that whilst the Norfolks and Fitzwilliam provided the initial capital in the large scale exploitation of their minerals, encouraged technological innovation and a degree of labour specialisation, they were unable fully to adapt their management structure and accounting methods to the new demands of mining.

CONCLUSION

The over-riding factor which prevented the large-scale exploitation of the South Yorkshire Coalfield before 1800, was the lack of a cheap form of transport. An exception were the collieries adjacent to the Don Navigation, and those in Sheffield which were able to take advantage of an expanding local industrial market. With the construction of a canal system which traversed the coalfield, easy access was gained to the Humber estuary, the Trent valley, and the Midlands, which stimulated mining on a large scale. Exploitation was also facilitated by the Coalfield's favourable geological features, whereby the major coal seams comprising the Barnsley, Parkgate and Silkstone beds, not only outcropped in the region but were consistent in quality, thickness, and with few faults except along the Don Valley. The proximity of ironstone to the coal seams led to the expansion of the iron and steel industry following the adoption of coke in the smelting process. Not only were the South Yorkshire ironworks the major market for the local collieries but they in turn placed regular orders for iron goods which led to the inter-dependence of the coal and iron industries before the railways opened wider markets.

Coal had been exploited for many centuries in those areas that were later to see large-scale mining development, and therefore many of the skills needed were already present in the region. This can also be said of the iron industry, with furnaces dating back into the seventeenth century at Wadsley, Attercliffe, Rockley and Chapeltown, and it was on the iron industry that the initial large-scale exploitation of the coal reserves depended. During the eighteenth century inadequate communications, small-scale industry, and a sparse population, severely limited colliery development in South Yorkshire as a whole. The Sheffield collieries were an exception. They developed with the cutlery industry in the seventeenth century, and after the widespread adoption of coke in the smelting process after 1750.

Until the eighteenth century coal mining remained an insignificant part of the Norfolk estate, with the landowner taking little direct interest. The collieries did not come under direct control until there was a slump in the market which meant it was difficult to find suitable lessees. These problems were illustrated in 1781 when Townsend and Furniss were unable to continue with their lease. In addition to a slump in sales that produced a serious financial crisis, Townsend and Furniss also experienced severe transport and geological difficulties. It was left to the Norfolks, who alone had the financial resources, to continue working the collieries and save the other industrial concerns in Sheffield from acute shortages of fuel. The Norfolk estate had no alternative but to manage the collieries, for upon them depended the industrial development of Sheffield and estate revenues.

The Norfolk estate not only assumed direct control of its Sheffield collieries, but continued to sink large capital sums in the exploitation of its coal reserves even when suitable lessees could have been found in the 1790's. Prior to 1796 there were many factors in favour of continuing with direct management, for between 1781-86 the estate was controlled by progressive trustees whose members included landed proprietors with experience of colliery management, whilst in John Curr there was a brilliant mining engineer. Apart from short-lived market fluctuations Sheffield was also an expanding coal market, with the adoption of coke in industrial processes and the expansion of the cutlery industry. Although the French and Napoleonic Wars interrupted overseas cutlery sales, this was to a large extent compensated by the construction of ironworks producing heavy castings for machine parts and munitions.

When the 11th Duke inherited the estate in 1786, he felt unable to shoulder the full burden of expenditure and risks of management, and on sinking an extensive colliery at Attercliffe took a partner in Vincent Eyre,

the land agent. By the late 1790's the partnership was facing serious financial difficulties brought about by adverse mining and market conditions, rising capital and working costs. The increased demand for coal and the exhaustion of the shallow seams, involved the partnership in sinking further extensive collieries and capital expenditure, with major improvements in the Sheffield and Manor Collieries and new 'winnings' at Attercliffe, Crooks Croft and the Ponds. The financial crisis which reached a peak in 1800, the death of Vincent Eyre and dismissal of Curr in 1801, appear to have persuaded Norfolk to sell off his colliery enterprise. A further factor was that his new partners, Catherine and Thomas Eyre, were almost certainly without mining experience, and so the whole burden of overseeing the enterprise would have fallen on Norfolk. An enterprise in such obvious difficulty would have been hard to sell, but as long as it remained under estate control further investment was necessary. This was illustrated by the sinking of a major colliery at Crooks Croft in 1803-4. Thus Norfolk was in the unenviable position of being the owner of an uneconomic enterprise and unable to divest his interest. But the longer Norfolk held on to the mines, the deeper became his financial commitment, whilst the huge cost of purchasing the enterprise outright would have deterred most prospective purchasers. To enable the purchase of the whole enterprise for £72,500, in 1805 Norfolk granted a lease on very favourable terms to a consortium of businessmen, who were able to spread the risks of management. Although the terms of the lease enabled the collieries to be sold, Norfolk had to forego an economic rent on the exploitation of his mineral reserves until the lease could be renewed in 1820.

The withdrawal of Norfolk from mining in 1805 did not mark the end of his problems, but the start of new difficulties associated with the lease and the lessees. The method of mining adopted by the lessees reflects a difference in attitude between the landed proprietor who was more concerned with the long-term exploitation of his minerals, and the capitalist entre-

preneur who aimed for more immediate financial returns. The lessees were able to achieve a significant increase in production, sales and profits by raising prices and cutting working costs by running down the capital equipment, and abandoning the extensive Crooks Croft Colliery in favour of working the more accessible coal on another part of the estate. Such mining practices and the state of the collieries left by the lessees, put in jeopardy the long term mineral revenues of the estate. It was out of necessity that Norfolk was forced to modify future leases in an attempt to guard against any possible repetition of past deprivations.

The capital investment made by the Norfolks in their collieries between 1781 and 1805, enabled the large-scale exploitation of coal on their Sheffield estate until by 1805 they were able to be sold for £72,500. The Norfolk collieries were among the most advanced technologically in the country, whose innovations and mining practices were adopted by mines in South Yorkshire and other coalfields. In addition, the vast increase in output greatly facilitated the expansion of the Sheffield iron industry. Except for the early 1790's the capital investment did not produce high profits and mineral revenues remained a small percentage of total estate revenue, and were unable to keep pace with the rise in agricultural rents. However, from 1793 to 1820 the market for coal was particularly volatile as the French and Revolutionary Wars interrupted the cutlery trade and after 1815 the heavy iron manufacturing sector experienced over-capacity and a post war slump. It was only after 1820 following a recovery in the iron industry, that Norfolk received any appreciable return on his mineral reserves.

During the early years of the eighteenth century the Norfolk collieries depended upon a large local market based on the fine-edged tool trade, which was later supplemented by the large-scale development of the iron and steel industry and rapidly expanding local population. Such reliance on a limited local market made the collieries vulnerable to any interruption in trade, as

was seen with the American blockade of 1807, the tightening of the continental system in 1810, and over-capacity in the iron industry following the cessation of hostilities in 1815. However, the long-term threat to the Norfolk collieries came not from any cyclical trade depression, but from outside competition, following improvements in transport. Both the Norfolks and Rockingham-Fitzwilliams opposed transport schemes which threatened their revenues, but encouraged those projects which promised to benefit their estates, such as the waggon-way built to carry coal into Sheffield in 1774 and a turnpike into Lancashire to open the Manchester market to Norfolk coal.(1)

It was to forestall competition from other pits that the Norfolks opposed any schemes that threatened to bring cheaper coal into Sheffield. The Don Navigation, for example, was terminated at Tinsley, and when the Sheffield Canal eventually extended the canal system into the town centre in 1819, Norfolk insisted it followed a line south of the Don to link up with the Handsworth Colliery. The local market was further protected in leases granted to local industrial entrepreneurs, which enabled Norfolk to close Booth's Colliery when it threatened to compete with estate collieries, whilst the terms of a lease granted for Darwin's Hesley Colliery limited coal sales to his immediate needs. The Norfolks' coal monopoly led to a coal shortage during periods of economic boom due to the inelasticity of supply, and as a consequence, prices increased. In general the lack of competition reduced the need to be cost effective, and led to inefficiency. High coal prices and under supply of the 1790's encouraged the sinking of collieries in competition to Norfolk, but the cost of transport eventually enabled the Norfolks to purchase most of these collieries by 1801. Although this reflected the difficulty of breaking the Norfolks' monopoly, it did emphasise their vulnerability once transport costs could be reduced.

The elimination of competition left the Norfolk collieries unprepared for the weakening of their monopoly, which occurred once the Sheffield Canal opened a direct and cheap route into Sheffield for the collieries along the Dearne and Dove Canal and Don Navigation. They had the advantage of being able to extract shallower coal containing fewer geological nonconformities than those in Sheffield, and as a consequence of their lower costs of production were able to undercut the price of Norfolk coal.

In many ways Rockingham and Fitzwilliam performed similar entrepreneurial functions as the Norfolks, for prior to 1763 Rockingham preferred to lease his collieries, taking them under direct management only when a suitable lessee was not available. Following the depressed state of the coal trade in 1763, for example, Rockingham found himself in direct control of the Elsecar, Lowwood, and Westwood collieries. Even though these collieries were very small concerns, Rockingham immediately took a personal interest in their development, and what little evidence exists, suggests that both Rockingham and Fitzwilliam were more closely involved with the management of their collieries than the Norfolks in their Sheffield mines. They were among those landowners whose response to economic opportunities '... was conditioned in part by their social outlook and their breadth of interests.'(2) During the 1760's, Rockingham was actively seeking new markets for Wentworth coal and acquiring knowledge of the technical details of management, especially in the field of drainage. Although Rockingham was prepared to invest in the exploitation of his coal resources, economic realism, determined by the high cost of carriage from Elsecar, ruled out any large-scale mining development. Indeed, it was only in association with the extensive Basingthorpe Colliery that any large-scale investment was carried out, with the construction of the Greasbrough Canal to carry coal from the colliery to the Don Navigation. Even so, the tentative approach to the construction of this canal, reflected a conservative attitude to large-scale investment by the landowner.

On inheriting the Wentworth estate in 1782 Fitzwilliam decided to continue with the direct management of the Lowwood and Elsecar collieries, but not before seriously considering an offer for the lease of Lowwood Colliery. The major reason for rejection of the offer, was the potential profitability of the colliery, following the high demand for coal in the 1790's. In addition, the poor state of the collieries in 1790 would have deterred prospective lessees. Both concerns needed considerable capital investment to continue their working, which could be supplied only by Fitzwilliam who alone had the necessary risk capital.

Fitzwilliam appreciated the potential mineral revenues which may have accrued if the experience of the highly remunerative Greasbrough Canal could be repeated, by driving a canal from the Don Navigation to Elsecar. Although plans were made towards this end, Fitzwilliam decided to support the more adventurous Dearne and Dove Canal scheme. This scheme not only encouraged Fitzwilliam to sink the extensive Elsecar New Colliery, but also stimulated Darwin to establish the Elsecar ironworks and Walker to set up those at Milton. Such developments provided a major market for Wentworth coal and revenue from working the Tankersley ironstone leased to the ironmasters.

The Fitzwilliams, unlike the Norfolks and many other great landowners, continued to control their collieries throughout the nineteenth century.(3) This can be attributed to three basic reasons: a keen and active interest in the exploitation of his mineral resources, a belief that it was their moral duty to be engaged in the purposeful development of the estate, although probably the major reason was the realisation of significant profits on capital invested. In addition, the Fitzwilliam collieries were not encumbered by the kind of serious working difficulties that were experienced in the Norfolk mines. Whereas Norfolk sold his collieries in 1805, Fitzwilliam made even greater capital investment in the exploitation of his coal reserves in the Rawmarsh - Greasbrough area, culminating in the opening of the extensive Park Gate Colliery in 1823.

In the exploitation of the deeper coal, Fitzwilliam had to invest in high cost capital equipment, including pumping and winding engines, rails, corves and tiplers, and to attract workers into an area of sparse population, new houses were constructed. As the Wentworth collieries were late into large-scale mining, they were able to take advantage of the pioneering innovations which had been introduced into the Norfolk collieries. Even so, the large scale exploitation of Fitzwilliam coal was to contribute towards the development of the South Yorkshire iron and steel industry and the capital investment made in the collieries between 1795 and 1830 was sufficient for Fitzwilliam to be able to take advantage of the rapid demand for coal after 1850.

It was the high cost of transport on the Wentworth estate that limited the market for coal, and as a consequence restricted the exploitation of the mineral reserves. The collieries depended upon the low demand from such estate activities as malting, lime burning, brick making and householders, but as a monopoly was held over the estate market, this allowed some protection for the collieries. As there was no possibility of a wider geographical market, Rockingham attempted to consolidate estate consumption by fostering lime and tile works, and extending the use of coal into various manufacturing processes, such as tar distillation and iron smelting. Unlike the Norfolk collieries with a large and expanding local market, the lack of cheap transport not only restricted the distance Rockingham-Fitzwilliam coal could be carried, but prevented other entrepreneurs such as iron-masters from establishing businesses in the Elsecar area. This put a restriction on the extent to which estate consumption could be raised.

While equally protective as the Norfolks of their estate markets, Rockingham and Fitzwilliam had more incentive to support those projects that offered an opportunity to break into more distant markets. Both Rockingham and Fitzwilliam subscribed to several turnpike trusts, such as the Wakefield

to Sheffield Trust and the Wentworth Trust, but it was the opening of the Dearne and Dove Canal which enabled the large-scale exploitation of the coal reserves on the Wentworth estate. Although the canal allowed several unsuccessful attempts to be made on the lucrative London market, their real market lay with the fast developing South Yorkshire iron and steel industry. The Dearne and Dove Canal not only opened up the markets in Rotherham and the Midlands, but enabled the Elsecar and Milton ironworks to be established which strongly reinforced the estate market. By controlling the supply of coal to the Elsecar and Milton ironworks, Fitzwilliam was able to dictate terms and prices. Leases granted to entrepreneurs insisted on the purchase of Fitzwilliam coal, which made it a relatively easy market to protect, and any excess production was carried into the wider markets of South Yorkshire and the Midlands. This monopolising policy was also extended into adjacent property in an attempt to overcome competitors both potential and real, lock up neighbouring proprietors' coal and extend the estate's mineral reserves. It was for this reason that the Southwell lease was acquired along with the purchase of the Haugh Colliery and the Kent, Roberts and Lundy estates. By 1830 the Fitzwilliam coal market was firmly established in the iron and steel areas of South Yorkshire. This created problems associated with over reliance on one product and area, for as with the Norfolks in Sheffield, any slump in the iron industry had an immediate and considerable effect on the demand for Fitzwilliam coal. Such dependence was not overcome until railways opened up wider and more diverse markets.

The promotion of schemes such as the Dearne and Dove Canal by the landed interest, enabled the large-scale exploitation of coal reserves which previously had been barely mined, and this in turn enabled demand from the rapidly expanding iron industry to be met. As the collieries developed more coal could be supplied and more orders for iron goods placed. There is evidence from a study of the Norfolk and Fitzwilliam estates that during times of boom and with the relative inelastic supply of coal from the collieries a monopolistic situ-

ation was created. In the long term the leading suppliers such as Norfolk and Fitzwilliam may have benefitted local industrialists as a relatively secure local market allowed the collieries to be worked on a more extensive scale, which with the introduction of high cost capital equipment raised output, lowered working costs and increased demand for iron goods. Although economies of scale were not initially transferred into lower prices, when improved forms of transport increased competition, this brought about a rise in supply and more stable prices. The effect of competition can be seen with the entry of Fitzwilliam coal, that could be worked at lower cost, into the Sheffield market following the completion of the Sheffield Canal in 1819, which forced the Norfolk lessees to reduce prices at the Handsworth Colliery or otherwise hold their prices steady.

The large-scale development of collieries called for a change in leasing, management, and accounting practices. As collieries were among the first extensive industrial units, landowners were often pioneers in the area of industrial organisation. Leases had to be arranged to protect the long term exploitation of reserves, raise revenue, achieve a greater flexibility of output in response to a change in demand, protect land and timber resources, and introduce a more equitable and reliable method of assessing output. The early eighteenth century leases with the emphasis on limiting output by fixing the number of hewers, and the calculating of rent at a fixed rate were inappropriate to large-scale mining. The larger collieries on the Norfolk and Fitzwilliam estates changed their leases from a fixed rental to one coupled with a royalty payment. These royalty payments were later modified from being based on a certain number of corves or waggons extracted, to a rate per acre, which could be more easily assessed and at the same time this allowed coal to be worked in relation to demand.

Leases aimed to achieve an equitable return to both parties, and a failure to obtain this could result in serious financial consequences. On the Norfolk

estate in 1781, an excessive rent and adverse working conditions led to the collieries being taken 'in hand', whilst the lenient lease granted in 1805 saw the mines overworked, exhausted, capital depleted and the abandoning of Crooks Croft Pit, to the detriment of the estate. It was through their leases that landowners were able to protect their coal monopoly by insisting that proprietors purchased coal from their estate, and colliery leases did not impinge upon the markets of estate managed collieries. As far as mineral leases were concerned, Norfolk and Fitzwilliam adapted successfully to the changing economic conditions. However, on the Norfolk estate the geological problems and increased competition did make the realisation of an equitable lease more difficult.

It was in the area of management and accounting that both Norfolk and Fitzwilliam were unable fully to adapt to the demands of the rapidly developing coal industry between 1780 and 1830. They looked upon their mining enterprise as an extension of other estate activities to be managed on similar lines by the land agent or house steward.

Prior to 1800 the South Yorkshire colliery proprietors often relied upon the expertise of viewers and consultants from the Northumberland and Durham coalfield until they were able to produce their own skilled mining engineers. The Norfolk collieries, for example, depended upon Curr, Locke and Nixon as agents, whilst the services of mining consultant John Buddle were called upon when required. The efficiency of any large-scale enterprise rests upon the ability to delegate areas of responsibility to realise the advantages of spcialisation, but in this Norfolk and Fitzwilliam were unable to come to terms. Although they were able to introduce greater specialisation on the production side, it was in management they were unable to adapt to changing circumstances. Even though the Norfolk collieries employed a full time superintendent from 1781, the position still called for a variety of skills and expertise, which included overall supervision of the working pits and reports

of their condition, keeping the accounts, marketing, pricing and employment as well as solving technical and engineering problems. The superintendent neither had the time nor appropriate skills in all areas of management. Curr for example, brilliant at solving engineering difficulties raised doubts concerning his management abilities.

A similar practice was present in the Fitzwilliam collieries, but as the concerns were small, when they were taken 'in hand', their supervision was placed with the house steward. This situation remained even when the collieries increased in number and scale, until by 1830 Joshua Biram had overall supervision of six working collieries including two very large concerns in the Elsecar New and New Parkgate collieries. The creation of a full time colliery superintendent had to await major managerial reorganisation in 1833. This lack of delegation of responsibility almost certainly detracted from working efficiency of the enterprise.

There appears to have been a deliberate policy on both estates of reducing the number of employees with executive and financial responsibility to the absolute minimum, in an attempt to forestall embezzlement and fraud. Even the authority of the superintendent was subordinate to the land agent Vincent Eyre, and at Wentworth to the solicitor-auditor Charles Bowns. However, the function and direct involvement in the collieries of these officers diminished as mining became more complex and specialised, and they reverted to supervision of finances and general advice.

A major weakness in the management structure was the landowner, which partially explains the very careful attention shown to the delegation of authority and expenditure. Both Norfolk and Fitzwilliam could only control the management of their collieries from a distance, due to their other political and estate responsibilities. On the Sheffield estate evidence suggests that considerable control over the collieries was exercised by Curr as superintendent and Vincent Eyre as land agent and partner, with Norfolk exercising

little direct supervision. This would partly explain Norfolk's slow response to the financial crisis of 1798-1800, the abandoning of Crooks Croft in 1812, and the adverse working practices of the lessees after 1805. Indeed it would appear that the first detailed report on the Sheffield collieries after they were leased in 1805 was not made until 1817. Although Rockingham and Fitzwilliam were more actively involved in the management of their mines they were, for the most part, absent from their Wentworth estate. As all policy decisions were taken by the proprietor this in itself could lead to inefficiency, for not being on site they were without the necessary intimate working details of the enterprise, and any interference could detract from the initiative of the superintendent. A proprietor with regular contact with his enterprise was in a position to appreciate the working problems and was thus more able to keep a check on expenditure and respond more quickly to changing economic conditions.

To encourage a content and efficient senior management and to attract other well qualified, capable, and experienced managerial executives, an appropriate level of salary has to be offered. Unfortunately this was not the case on either the Norfolk or Fitzwilliam estates. In Sheffield, Curr commented on his low salary in relation to the duties he performed, which did not rise with the level of inflation during the last decade of the eighteenth century. The situation on the Wentworth estate was even more pronounced as Bowns had to reluctantly seek a rise in salary in 1811 which an independent body agreed was far too low. Joshua Biram whose responsibilities had increased considerably between 1795 and 1830 received the same basic salary over the period, with annual gifts which varied at the discretion of the landowner, and it was left to Benjamin Biram to ask for a salary increase on behalf of his father. This reflects the paternal approach to the landowner's employees, which may have been applicable to an earlier agrarian society, but not in an increasingly industrial and competitive economy during a period of inflation.

Although the landowner tended to neglect the remuneration of senior managers, in spite of their increased level of responsibility, he came to rely upon them increasingly, as collieries became more complex. Once a reliable, conscientious and capable agent was employed their families and descendants were also employed. In Sheffield John Curr brought with him several brothers, and William Locke, a colliery agent, had his own son employed. On the Wentworth estate Benjamin Hall the house steward, was succeeded by his nephew Joshua Biram, and then by his son Benjamin Biram. This form of nepotism was also used among the workforce as a whole, with several generations of workers being employed.

The landowner's paternalism towards his estate workers was transferred to the colliery employees. On both the Norfolk and Rockingham-Fitzwilliam estates, tools were provided by the landowners and at Wentworth the occasional feast was given in addition to a system of allowances for the sick, widowed, injured or retired. It is not surprising that the landowner was slow to change practices that had been found appropriate for generations. Indeed in the words of Mingay '... industrial activity was a logical extension of the development of their estates.'(4) Although earlier managerial and accounting practices could be equally applied to agricultural and non-agricultural sectors of the estate with success, by the late eighteenth century the landed proprietor had to contend with a rapidly changing economy, in which the previous agrarian practices became increasingly anachronistic. This can be said of the method of accounting in which Norfolk and Fitzwilliam had varying degrees of success in adapting to the economic development of their collieries. The steward and master system of accounting, developed under an agrarian society, was practical for the management of very small enterprises, but inadequate for large scale industrial units. Once high-cost capital equipment was introduced and added to the current accounts, profits were grossly distorted. To overcome this Norfolk and Fitzwilliam created a separate capital account, but as no form of capital depreciation was introduced it still made the accurate calculation of profits

difficult. They did deduct from the balances interest on what their capital would have returned if invested elsewhere, although this was still a variant of opportunity cost accounting, as it still ignored the factor of depreciation. On the Wentworth estate the accounts were further complicated by adding some current items of expense, such as repairs, to the capital account, and whilst these were negligible in a new colliery, with the passing of time they became increasingly dominant in the accounts. Except in a very generalised form there was no common method of accounting between the Norfolk and Fitzwilliam estates, to enable an accurate comparison or calculation of profits. In spite of this, it is what each landowner looked upon as profit which is important in explaining his attitudes towards his mining enterprises and his level of direct involvement.

Although the Norfolk and Rockingham-Fitzwilliam families did not follow the general South Yorkshire practice of remaining colliery lessors, they were typical of many of the great landowners in the country by using their substantial agrarian revenues or mortgages on land to support the necessary capital investment required in large-scale colliery development. In common with the lesser landowner, the Norfolk and Rockingham-Fitzwilliam families promoted transport schemes both inside and out of parliament when they appeared to assist the economic development of their estates. In relation to the economic development of South Yorkshire, Norfolk and Fitzwilliam played a similar role to that assumed elsewhere by Dudley, Durham, Londonderry, Devonshire, Lonsdale or Lowther. Even so, many of these great landowners, such as Dudley in the Black Country or Devonshire at Barrow-in-Furness, invested more in the exploitation of their mineral reserves and built up more substantial industrial empires.

The level of capital investment on the landed estates was generally related to the direct involvement and attitude shown by the landowners. This is well illustrated by Devonshire and Dudley, who made a major contribution to the economic expansion of their regions and to a lesser extent so did Norfolk and Fitzwilliam in South Yorkshire. Of almost equal importance was the managerial competence of their local agents, as any mis-management as experienced on the Dudley and Lowther estates, could threaten the economic basis of their industrial enterprises. Although Norfolk and Fitzwilliam were fortunate in the employment of efficient and capable colliery agents, there appears some doubt of the managerial expertise in the Norfolk collieries.

Norfolk and Fitzwilliam provide examples of those great landowners who gave up their mining interests and those who continued with direct management respectively. However, the landed proprietors who developed an extensive mining enterprise, such as Norfolk and Dudley, found it difficult to sell their enterprises. The exploitation of coal was on such a large scale that generally no one entrepreneur could purchase the whole enterprise, sustain the level of investment or shoulder the risks of management. It was left therefore, to consortium of businessmen to take over the role of entrepreneurs and provide the investment previously sustained by the landowner. The Norfolk collieries were affected by local factors which influenced the proprietor's decision to revert to the position of lessor. These included adverse working conditions that necessitated large scale capital expenditure and the exploitation of coal at greater depths which adversely affected profits, in addition to the depressed state of the market prior to 1801. There were also more general factors in persuading the landed proprietor to divest direct control of the collieries such as the increase in cost inflation and decline in real profits. Fitzwilliam remained among the few landowners to continue with his mining enterprise, apparently because of reasonable profits in an expanding market and as the Fitzwilliam estates had not exploited coal on a large scale, there were considerable coal reserves at shallow depths which kept down the cost of working.

Nevertheless both the Norfolk and Rockingham-Fitzwilliam families provided the necessary capital for the large-scale exploitation of coal on their estates, and contributed towards the industrialisation of South Yorkshire.

THE LANDED INTEREST AND THE DEVELOPMENT OF THE SOUTH YORKSHIRE COALFIELD 1750 TO 1830

I.R. MEDLICOTT

M. PHIL

1981

VOLUME 2 OF 2

REFERENCES

(Note: Footnote references are started afresh for each chapter)

CHAPTER ONE

(1) E. Richards, Economic History Review, 2nd series, Volume 29 (1976), 511, review of the book G. Mee, Aristocratic Enterprise, (Glasgow, 1975)

(2) J.T. Ward, "The Beaumont Family's Estates in the Nineteenth Century", Institute of Historical Research Bulletin, 35 (1962), 169-171.

(3) ibid., 171-172 - total rents amounted to £13,105 14s 8d with the collieries contributing £1,470 7s 4½d in 1829.

(4) J.T. Ward, "West Riding Landowners and Mining in the Nineteenth Century", Yorkshire Bulletin of Economic and Social Research, 15-16 (1963-4), 68.

(5) E. Elmhirst, A History of the Elmhirsts: The Peculiar Inheritance (Place of publication not stated, 1951), pp. 94, 102.

(6) Ward, "West Riding Landowners ...", 67.

(7) Ward, "The Beaumont Family's Estates ...", 170.

(8) ibid., 170.

Ward, "West Riding Landowners ...", 70.

(9) J.P. Prince, Parish of Silkstone (Penistone, 1922), pp.98, 105.

(10) Ward, "West Riding Landowners...", 73.

(11) G.G. Hopkinson, 'The Development of Lead Mining and of the Coal and Iron Industries in North Derbyshire and South Yorkshire 1700-1850' (unpublished Ph.D. thesis, University of Sheffield, 1958), pp.25-33.

(12) Elmhirst, op. cit., p. 94.

(13) J. Priestley, Navigable Rivers and Canals, (1831), pp. 53, 55, 186.

(14) G.G. Hopkinson, "Railway Projection and Construction in South Yorkshire and North Derbyshire, 1830-50", Transactions of the Hunter Archaeological Society, Volume 9 (1964-9), 13, 14.

(15) J.T. Ward, "West Riding Landowners and the Railways", Journal of Transport History, Volume 4 (1959-60), 245-7.

(16) Ward, "The Beaumont Family's Estates ...", 170.

Ward, "West Riding Landowners ...", 66.

J.T.Ward, "Landowners and Mining", in J.T. Ward and R.G. Wilson (eds.), Land and Industry: The Landed Estate and the Industrial Revolution (Newton Abbot, 1971), pp. 84-5.

(17) D. Spring, "English Landowners and Nineteenth-Century Industrialism", in Ward and Wilson (eds.), op. cit., pp. 16-18.

(18) ibid., p. 35, Appendix XIV.

(19) Ward, "Landowners and Mining", and Spring "English Landowners ...", in Ward and Wilson (eds.), op. cit., pp. 49, 68, 70, 74.

(20) S. Pollard, "Barrow-in-Furness and the Seventh Duke of Devonshire", Economic History Review, 2nd series, Volume 8 (1955-6), 213.

(21) ibid., 215 - 16.

(22) ibid., 221.

(23) T.J. Raybould, The Economic Emergence of the Black Country (Newton Abbot, 1973), p. 11.

(24) ibid., p. 33. J.U. Nef, The Rise of the British Coal Industry, Volume 1 (1932), pp. 66-68.

(25) Raybould, op. cit., p. 33.

(26) ibid., pp. 62-3.

(27) J.E. Williams, "Whitehaven in the Eighteenth Century", Economic History Review, 2nd series, Volume 8 (1955-6), 399.

(28) O. Wood, "A Cumberland Colliery during the Napoleonic War", Volume 21 (1954), 58-9.
Economica N.S. Volume 21 (1954), 58-9.

(29) ibid., 60.

(30) Nef, op. cit., pp. 360-361. D. Spring, "The Earls of Durham and the Great Northern Coal Field, 1830-1880", Canadian Historical Review, Volume 33 (1952), 238.

Spring, "The Earls of Durham ...", 242.
(31) Spring, "The Earls of Durham . . . ", 242.

(32) W. Fordyce, A History of Coal, Coke, Coalfields and Iron Manufacture in Northern England (Newcastle-upon-Tyne, 1973), (First edition, 1860), p. 92.

(33) T.W. Beastall, A North Country Estate: The Lumleys and Saundersons as Landowners, 1600-1900 (Chichester, 1975), pp. 34-9.

(34) J. Davies, Cardiff and the Marquesses of Bute (Cardiff, 1981), pp. 246, 247, 270.

(35) ibid., p. 217.

(36) ibid., p. 218.

(37) ibid., pp. 218-219.

(38) Spring, "English Landowners ...", in Ward and Wilson (eds.), op. cit., pp. 48-9.
F.M.L. Thompson, English Landed Society in the Nineteenth Century (1963), p. 263.

(39) C.P. Griffin, 'The Economic and Social Development of the Leicestershire and South Derbyshire Coalfield, 1550-1914' (unpublished Ph.D. thesis, University of Nottingham 1969), Volumes 1-3, 174-5, 780.

(40) Spring, "English Landowner ...", in Ward and Wilson (eds.), op. cit., pp. 19-25.

(41) Raybould, op. cit., pp. 234-6.

(42) Wood, op. cit., 54,

(43) Griffin, op. cit., p. 304.

(44) Spring, "English Landowners ...", in Ward and Wilson (eds.), op. cit., p. 35.

(45) Spring, "The Earls of Durham ...", 246.

(46) ibid., 251.

(47) Spring, "English Landowners ...", in Ward and Wilson (eds.), op. cit., p. 33. Thompson, op. cit., p. 264.

(48) Beastall, op. cit., p. 49.

(49) G.E. Mingay, English Landed Society in the Eighteenth Century (1963), p. 193.

(50) D. Spring, "The English Landed Estate in the Age of Coal and Iron, 1830-1880", Journal of Economic History, Volume 11 (1951), 5.

(51) Spring, "The Earls of Durham ...", 242.

(52) Ward, "Landowners and Mining", in Ward and Wilson (eds.), op. cit., pp. 73-4.

(53) Fordyce, op. cit., p. 92.

(54) ibid., p. 92.

CHAPTER TWO

(1) The South Yorkshire estates were divided by Henry, Sixth Duke of Norfolk, who bequeathed extensive property to his second wife Jane Bickerton. She in turn gave the Kimberworth and Rotherham estates to the Earl of Effingham. A. Gatty, The Noble and Illustrious Family of Howard, Local Pamphlets, Volume 119 (1879), pp. 18-25, Sheffield City Libraries (hereafter S.C.L.)

(2) Worksop Manor contained some 500 rooms but the building, with its valuable pictures and statues, was burnt to the ground on 21 October 1761, at a loss of £100,000. Gatty, Local Pamphlets, Volume 119 (1879), pp. 27-8. The Complete Peerage, G-E-C, Volume IX (1936), p. 632.

(3) Charles Howard of Greystock (1720-86) was a great-grandson of Henry Frederick Howard, 25th Earl of Arundel and son of Thomas Howard who had married Lady Alethea Talbot. Charles Howard inherited the titles: Duke of Norfolk, Earl of Arundel, Surrey and Norfolk, Earl Marshal, Lord Fitzalan, Clun, Oswaldestre and Mautraves. He married the co-heir, Katherine Brockholes, 8 November 1739. Between 1777 and 1786 the Earl of Surrey held the Sheffield estates under trustees appointed by Duke Edward's settlement of 1767. Complete Peerage, Volume IX (1936), pp. 632-633.

(4) Complete Peerage, Volume IX (1936), pp. 633-4.

(5) J. Hunter, Hallamshire (Sheffield, 1869), pp. 162, 223. On the Sheffield estates no 'material alienations' had been made between 1297 and 1802 on the original property. Charles received only £100 per acre, but were later re-sold at three times their original price. Other similar acts followed.

(6) J.T. Ward, "Landowners and Mining", in J.T. Ward and R.G. Wilson (eds.), Land and Industry: The Landed Estate and the Industrial Revolution (Newton Abbot, 1971), p. 71.

(7) Arundel Castle Manuscripts (hereafter A.C.M.), S185 The Abstracted

Account, S213 Distribution of the Duke of Norfolk's gift of Coal 1759, S.C.L.

(8) The Duke of Norfolk held eight principal markets in Sheffield in 1888/9, earning £10,000 which along with the Duke of Bedford's London markets (Covent Garden), were probably the most lucrative in the country. D. Spring, "The English Landed Estate in the Age of Coal and Iron: 1830-1880", Journal of Economic History, Volume 11 (1951), 10 - 11.

(9) John Carr, 1723-1807, was extensively employed in the north of England from 1750 to the end of the century. In 1760, he designed Harewood House, 1762 Tabley in Cheshire, 1776 Basildon Parkin, Berkshire, the Town Hall at Newark and County Court House at York. Wentworth Woodhouse was one of the largest Whig country houses of the eighteenth century. The house was occupied by the Earl mainly in the winter months with the rest of the year spent at Milton or the London houses in Grosvenor Square and Wimbledon.

(10) Wentworth Woodhouse Muniments (hereafter W.W.M.) Steward Papers 5(i) S.C.L.

(11) D. Spring, "Earl Fitzwilliam and the Corn Laws", American Historical Review, Volume 59 (1953-54), 287.

(12) ibid., 290.

(13) G. Mee, Aristocratic Enterprise (Glasgow, 1975), p. 8.

(14) W.W.M. St. p. 3 (iii), (viii), S.C.L.

The Fitzwilliam employees had the right to address themselves directly to the Earl over the heads of the agents. The Earl, on hearing about an employee, asked in letters to his agent about his welfare. There appears to have been a genuine interest shown in the work force.

(15) A.H. Green and R. Russell, Geology of the Yorkshire Coalfield (1878), p. 1. Geology of the Country Around Barnsley (1947), pp. 1 - 2. P. Jeffcock, "On the Coal and Iron Mining of South Yorkshire", The Institute of Mechanical Engineers (1862), 68 - 9.

(16) Arthur Young, A Six Months Tour Through the North of England, Volume 1 (1769), pp. 136, 278.

(17) J. T. Jeffcock, Parkin Jeffcock: Civil and Mining Engineer. A Memoir by his brother J. T. Jeffcock (1867), pp. 1 - 2.

(18) Geology Around Barnsley, p. 1.

(19) The general direction of dip of the coal seams in the Sheffield area is at an approximate rate of 1 in 9. R. A. Mott, Sheffield Telegraph, Sheffield Newspaper Cuttings, Volume 27 (1933), p. 46. S.C.L. E. Sorby, "Coal-Mining Near Sheffield from 1737 to 1820", The Midland Institute of Mining, Civil and Mechanical Engineers, Volume LXV (1923), Plate 1. Geology Around Barnsley, pp. 2 - 9.

(20) The Barnsley coal seam has been variously called: Warren House, Gawthorpe, Hobbins, Lowood, Elsecar Coal, Hawmarsh Nine Feet, Garrowtree Nine Feet, Darnall, Top Hard, Rifler. H. Rhodes and M. Rhodes, "Methods of Working the Barnsley Seam of the South Yorkshire Coalfield", Transactions of the Institute of Mining Engineers, Volume 63 (1921-22), 401.

(21) ibid., 402.

(22) G. G. Hopkinson, "The Development of the South Yorkshire and North Derbyshire Coalfield, 1500-1775", Transactions of the Hunter Archaeological Society, Volume 7 (1951-57), 295.

(23) See Appendix II

(24) Other names for the Parkgate seam include: Manor, Old Hards, Dawgreen Coal, Brown Metal Series, Two-Yards Coal, and Firthfield Series.

(25) Geology Around Barnsley, pp. 14 - 15.

(26) South of Cawthorne the seam has been referred to as: Sheffield Coal, Bromley Coal, Thorncliffe Deep Coal and Stainborough Coal. North of Cawthorne the bed which is looked upon as corresponding to the Silkstone coal is the: Blocking, Cookson's, Toftshaw, Furnace or Barcelona Coal. Green and Russell, op. cit., p. 228.

(27) ibid., pp. 228 - 9.

(28) The High Hazle's coal was named after the place where it was first worked, near a house of that name. To the north of Sheffield it is called Kent's Thick or Kent's Five-Foot coal, which divides into two beds from Masborough to Denaby and thins out towards Barnsley. The Fenton's Thin Seam over most of the area comprises of two seams separated by a dirt parting known as the Low and High Fenton coals. It outcrops at Wombrough through Hood Green, High Green, Thorpe Common, to the south of Greasbrough. The Thorncliffe Thin coal, sometimes called Walker's Thin, had an average thickness of between 1 foot 6 inches and 2 feet 6 inches, outcropping near Stainborough Fold, through Wortley Park, Westwood, Chapeltown, Thorpe Common, and Dropping Well. Geology Around Barnsley, pp. 14 - 15.

Green and Russell, op. cit., p. 399.

(29) The composition of the Claywood ironstone: 31.92 per cent iron, 2.12 per cent lime, 13.50 per cent silica. Geology Around Barnsley, p. 142.

(30) The Tankersley ironstone seam contained three or more courses, consisting of bands or layers of nodules in shale varying from 2 - 8 ft. or more. Another name for the seam was the Musselshell ironstone; ibid., p. 142.

(31) Iron content: Swallow Wood ironstone 26.79 per cent metallic iron; Thorncliffe Black Mine at Parkgate 34.16 per cent metallic iron; Thorncliffe White Mine at Parkgate and Thorncliffe gave 32.00 per cent metallic iron yielding 1,500 tons per acre. P. Jeffcock, op. cit., pp. 71 - 2.

(32) Large landowners with consolidated land holdings included: the Duke of Norfolk, Sheffield estate; Earl Fitzwilliam, Wentworth estate; Wortley family at Wortley; Earl of Strafford, Stainborough estate; and Earl of Effingham at the Holmes in Rotherham.

(33) R.H. Cox, "The Development of the Coal Industry in South Yorkshire before 1830" (Unpublished M.A. thesis, University of Sheffield, 1960), p. 18.

(34) ibid., p. 15. The Fitzwilliams were Yorkshire landowners at Emley and Sprotborough under the Normans, but settled at Milton in Northamptonshire in the fifteenth century. J.T. Ward,"The Earls Fitzwilliam and the Wentworth Woodhouse Estate in the Nineteenth Century",The Yorkshire Bulletin of Economic and Social Research, Volumes 11-12 (1959-60), 19.

(35) Mott, Newspaper Cuttings, Volume 27 (1933), p. 46, S.C.L.

(36) A.S.Ellis, Yorkshire Deeds (part II), Yorkshire Archaeological Journal, Volume 12 (1893), 236 - 7.

(37) Early pits were either driven into the valley sides or sunk vertically into the ground to form 'bell pits' comprising of a shaft 12 - 20 yards deep which 'belled' out laterally on reaching the coal seam. Before the sides collapsed the pit would be abandoned and another sunk nearby.

(38) L. Stone, "An Elizabethan Coalmine", Economic History Review, 2nd Series, Volume 3 (1950-1), 97 - 102.

(39) As colliery workings became deeper and more extensive, there was an increased possibility of meeting firedamp or methane gas.

(40) Stone, op.cit., 100 - 2.

(41) W.W.M. F98 Elsecar fornightly account, S.C.L.

(42) Cox, M.A. thesis, pp. 56 - 60.

(43) Mott, Newspaper Cuttings, Volume 27, (1933), p. 46, S.C.L.

(44) A.K. Clayton, "Coal Mining at Hoyland", Transactions of the Hunter Archaeological Society, Volume IX (1966) p.76,The Barnsley coal seam outcropped behind Stead Farm, and in 1957 old workings were revealed when borings were taken for opencast mining. On Fairbank's plan of Hoyland in 1771, an adjacent field is referred to as "Coal Pit Close".

(45) J.T. Prince, Parish of Silkstone (Penistone, 1922), p. 97.
J. Wilkinson, Worsbrough: Its Historical Associations and Rural Attractions, (Barnsley, 1872), p. 247.

(46) The lease further specified that coal could only be worked from two

pits and not employ more than ten colliers, and at the end of the lease two pits were to be left in working order. Hopkinson, op. cit., 301 - 2.

(47) Except for the collieries belonging to William Spencer on Attercliffe Common waste, Mott, Newspaper Cuttings, Volume 27 (1933), p. 46, S.C.L.

(48) The making of coke was similar to the charcoal burning process whereby lumps of 'hard' coal were piled on the ground with small coke dust and then ignited. This process was very inefficient as it involved considerable wastage of coal. A later improvement used small coal in bee-hive shaped ovens, which became the general method adopted in the nineteenth century.

(49) W.W.M. Estate Rentals A231. Newman and Bond Collections (hereafter N.B.C.), 300, S.C.L.

(50) This comprised of five colliers and four labourers. W.W.M. F98/8, S.C.L.

(51) W.W.M. D 1727, A 222, S.C.L.

(52) At Silkstone in 1736, Mr. Cotton leased for 16 years - land on the Moorend estate from Lord Strafford of Wentworth Castle. The coal was worked on a small scale by bell pits. In 1745, a Mr. Johnson was selling coal at ten pulls for one shilling (eight pulls equalled one ton) near Nabbs Farm. Sidney Wortley paid £1 per annum to the Duke of Leeds in 1711 for a farm and a coal mine on Barnsley Moor. Prince, op. cit., p. 97.
Cox, M.A. thesis, p. 99. W.K. Martin, History of Wath-upon-Dearne, (Wath, 1920), p. 77.

(53) J. Goodchild, The Coal Kings of Yorkshire (Wakefield, 1978), pp. 15, 59.

(54) Between 1750-75, the Elsecar colliery worked at a depth of 15 yards, Ecclesall 14 yards, and Basingthorpe 25 yards. The Elsecar

colliery had five shafts in 1757, Ecclesall seven pits in 1758, and Sheffield Park seven pits in 1765.

(55) T.S.Ashton and J. Sykes, The Coal Industry of the Eighteenth Century (Manchester, 1929), p. 6.

CHAPTER THREE

(1) G. E. Mingay, English Landed Society in the Eighteenth Century (1963), p. 190.

(2) T. S. Ashton and J. Sykes, The Coal Industry of the Eighteenth Century (Manchester, 1929), p. 2.

(3) L. Stone, "An Elizabethan Coalmine", Economic History Review, 2nd Series, Volume 3 (1950-51), 97.

(4) E. Sorby, "Coal-Mining Near Sheffield from 1737 to 1820", The Midland Institute of Mining, Civil and Mechanical Engineers, Volume LXV (1923), 1.

(5) 'Mr. Eyre paid Mr. Bowden for the materials at Sheffield Pitts when the Duke took them into his own hands - (vide his accounts) 194.16.9½. The condition Mr. Bowden left the colliery in at Michaelmas when his lease expired:

Wood Pitts: One Pitt done in 5 weeks
Another done in 12 weeks
Another done in 15 weeks
Another lasted 3 months to Michaelmas 1760.'

A.C.M. S195B, S.C.L.

(6) A.C.M. S195B, S.C.L.

(7) A.C.M. S195B, S.C.L.

(8) A.C.M. S195B, S.C.L.

(9) A.C.M. S177 Receipt Book. Cash Accounts for the Sheffield Estate, S.C.L.

(10) A.C.M. S185(II) S.C.L.

Rents received from the 9th Duke of Norfolk's collieries 1771 - 2:

		£	s	d
1.	Fullwood Moor Colliery, George Smilter	3	3	0
2.	Handsworth Colliery, Reverend Stacye	35	0	0
3.	Oughtibridge Colliery, Messrs Kenyon, 3 years' rent	30	0	0
4.	Sheffield Collieries, Townsend and Furniss	1,000	0	0
5.	Hesley Colliery, G. Phipps & Partner	52	10	0
6.	Handsworth Colliery and Hall Leys Close, Reverend Stacye, a half-year's rent	15	0	0
		£1,135	13	0

(11) Cash Accounts of the Sheffield Estate, 23 June 1777:

	£	s	d
"Mr James Furniss - one year due Mich^{s} last	67	17	6
D^{o} and G.T. for Paddocks Farm D^{o} late Rotherham ..	29	0	0
Ditto for Gleadleys Colliery Ditto	50	0	0
Ditto for old Coalyard Ditto		7	0
D^{o} for land late Clay's D^{o} new rent	14	14	0
Ditto for nursery field Ditto	5	0	0
The above are fixed rents			
Ditto for lands to the Colliery old rent one year due Ditto ..	40	0	0
Ditto for lands late Bowden Ditto	22	10	0
Ditto for Barn at the Manor D^{o}	3	3	0
Casual (To increase of Rent due Michaelmas 1776 for the three last articles not in the Rental must be Casual see Acct. Stated.	18	4	9 "

A.C.M. S179, S.C.L.

(12) A.C.M. S215, S.C.L. Report on a colliery in Sheffield Park 1773 S.C.L. The colliery at the time was worked at a depth of 50 fathoms, with coal drawn in 'Kibbles' fixed to sledge-trams holding approximately 10 pecks.

(13) A.C.M. S215, S.C.L.

(14) A.C.M. S217, S.C.L. Report by John Curr 1779 on the Norfolk Collieries leased to Townsend and Furniss. They paid interest of £10 per cent on £3,200 and £5 per cent on £2,000 advanced.

John Curr 1756-1823 was born and brought up in County Durham, where he also received his training as a colliery viewer. There is no conclusive evidence to show why he was employed as a viewer to the Sheffield collieries of the Duke of Norfolk. When the collieries were taken into direct estate management in 1781, Curr was appointed as the Superintendent of the collieries until his dismissal in 1801. He became one of the leading mine engineers whose innovations facilitated the development of large-scale mining. After leaving Norfolk's employment, he was a pioneer in the use of stationary engines, and in 1805 one was installed at Birtley near Gateshead to

haul coal on the surface. In 1792 he established a foundry, leased from Norfolk, to manufacture engine cylinders and other iron castings, and later set up a business to produce the flat ropes he invented. However, no evidence has been found to show where he acquired the capital to establish his iron foundry, the lease of which was purchased from Norfolk in 1804. There is no biography. But see: R.L. Galloway, Annals of Coal Mining and the Coal Trade, Volume 1 (Newton Abbot, 1971), pp. 321-369. R.A. Mott, "Tramroads of the Eighteenth Century and their Originator, John Curr", Transactions of the Newcomen Society, Volume XLII (1969-70), 3-7. A.C.M. S205, S.C.L.

(15) A.C.M. S217, S218, S.C.L. Mott, op. cit., 4.

(16) A.C.M. S217, S.C.L.

(17) A.C.M. S217, S218, S220, S.C.L. Reference to the Gleadless Colliery disappears in 1781 and reappears in 1803.

(18) Several writers have suggested that the Duke of Norfolk took control of the collieries at Michaelmas 1779 - Mott, op. cit., 4.

(see over)

However, in a lease of the collieries by the Duke of Norfolk to Vincent Lyre, 1 September 1789, is stated:

" . . . payment to Mr Geo. Townsend his Exors Admin. or Assos. sums from time to time due in respect of principal or interest monies agreed paid by Chas. D. of N. upon delivering up Sheffield Park Coll. into hands D. of N. at Lady Day 1781." A.C.M. SD4 S.C.L.

The account books of the colliery commence from 31 March 1781 to reinforce the case for direct control in 1781. A.C.M. S196, S.C.L.

(19) The depression in the coal market was not a local but a national phenomena. In County Durham, for example, the Lumley Colliery under management of the Earl of Scarbrough suffered a price reduction of 4s a chauldron on the London market and by 1780 coal was having to be stockpiled. By 1781 the decline in coal sales was severe at the Middleton Colliery, near Leeds, where only one pit worked a second shift, three were closed, and another had been idle for five months.

T. W. Beastall, A North Country Estate: The Lumleys and Saundersons as Landowners, 1600-1900 (Chichester, 1975), pp. 31 - 2.

G. Rimmer, "Middleton Colliery (1770-1830)", Yorkshire Bulletin of Economic and Social Research, Volume 7 (1955), 41.

(20) The Duke and Duchess of Norfolk were each to receive £1,000 from the Sheffield estate. The estate remained under the control of trustees until 1786 when it was inherited by 11th Duke of Norfolk.

A.C.M. SD 228-231, S185, S.C.L.

(21) The Wood Pits were also known as the Sheffield Park Colliery.

A.C.M. S221, S.C.L.

(22) During May 1781, five horses were purchased in anticipation of opening a new pit, and in:

'September 1783: To the Sinkers for sinking a pit in Mellors fields 90½ yds deep at 19s p. £53 16 3.' A.C.M. S223, S198, S.C.L.

(23) 19 - 26 February 1785. A.C.M. S198, S.C.L.

(24) Vincent Eyre is described in the Sheffield Local Register 200 - 1857, Volume 1, (Sheffield, 1830), p. 94, as the banker and agent to the Duke of Norfolk. It was not unusual for the land agent to be financially involved in their employers' estates. In 1782 Bassett, the land agent to the Earl of Scarbrough, joined with three others in purchasing shares in 'a ship' to move Lumley coal to London. Bassett also loaned the estate £800 towards the enclosure of Hucknall at 5 per cent interest. Over the period Bassett worked for the estate, he was owed £3,000. Beastall, op. cit., pp. 217 - 18.

(25) A.C.M. S274, S.C.L.

(26) A.C.M. SD666, S.C.L.

(27) A.C.M. SD666, SD4, S.C.L.

(28) A.C.M. S274, S.C.L.

(29) Mingay, op. cit., p. 193.

(30) A.C.M. S224, S.C.L. Appendix XIX

(31) A.C.M. S202, S215, S.C.L.

(32) A valuation of the collieries in 1805 records two pumping engines with 61" and 50" cylinders. John Curr's book for colliery viewers gives the expense for such engines at £1,556 and £1,146 respectively. If the two other engines had cylinders of only 30", this would add a further £1,200. By 1805 only two engines were in use. The main engine with a 61 inch cylinder was located on Attercliffe Common and assisted, when required, by another engine with a 50 inch cylinder at the High Hazles Pit. The Attercliffe Colliery took the name of the Handsworth Colliery in 1803 when the High Hazles estate in Handsworth was purchased from Earl Fitzwilliam to enable the continued working of the colliery. A.C.M. 205, S.C.L. J. Curr, The Coal Viewer and Engine Builder's Practical Companion (Sheffield, 1797), p. 95.

(33) A.C.M. S274, S.C.L.

(34) A.C.M. SD18, S.C.L.

(35) A.C.M. S223, S226, S.C.L. Appendix III. Of the two possible sites

at the Ponds or Crooks Croft, the former was recommended as the most viable. The Ponds Colliery was expected to work 187 acres at seven acres per annum and last for 27 years.

(36) A.C.M. S205, S226, S.C.L. The valuation of £12,656 5s 9d for the collieries represents only the stock, the complete valuation - including property, fodder and animals - was £16,515 7s 3½d.
R.A. Mott, Sheffield Telegraph, Sheffield Newspaper Cuttings, Volume 27 (1933), p.47 states that the Crooks Croft Colliery was sunk in 1812. However, the colliery had been opened by 1805.
A.C.M. S205, S.C.L.

(37) A.C.M. S274, S205, S.C.L. John Curr valued the Dore House Colliery in 1800 at £2,999 12s 6d. MD 1735, S.C.L. It was purchased in 1801 for £5,313 10s 0d in ten instalments, being charged to the Sheffield Collieries account. The first, fourth and fifth instalments were borrowed from Vincent Eyre's private estate and repaid with interest from the Sheffield Collieries account.
A.C.M. S205, S.C.L.

(37a) A.C.M. S201, S202, S274, S.C.L. Curr, op. cit., p. 95.

(38) The Prior Goose Pit of Lord Ravensworth in 1787 was supposed to have cost £20,000 to sink, and a new 'winning' on the Earl of Scarbrough's estate at Lumley between May 1771 and October 1783 involved an expenditure of £17,000. Even the Middleton Colliery worked by Brandling had dead stock valued at £13,080 to which another £5,000 might be added for livestock in 1808.
S. Pollard, The Genesis of Modern Management: A Study of the Industrial Revolution in Great Britain (1965), p. 63.
Boastall, op. cit., p. 34.
Rimmer, op. cit., 43.

(39) The actual and estimated capital investment in the exploitation of coal by the Norfolk Collieries 1781-1801; (see over)

(39) Contd:

		£	s	d
1.	Expenditure at Wood Pits by 1784	4,700	0	0
2.	Attercliffe Colliery 1786-96	16,244	10	11
3.	Machine for drawing coal at Hesley Colliery	250	0	0
*4.	Ponds Colliery opened 1789	4,500	0	0
*5.	Crooks Croft Colliery opened 1804	8,190	0	0
6.	Darnall Colliery purchased 1798	8,000	0	0
7.	Dore House Colliery purchased 1801	5,315	10	0
		£47,198	0	11

* Estimated Expenditure.

A.C.M. S205, S214, S.C.L.

(40) Between 1780 and 1790 the daily earnings for hewers rose by at least 12½ per cent, the cost of horses by 40 per cent and animal feedstuffs by more than 25 per cent. Fodder crops that were 13s 2d a quarter in 1780 had reached 18s 6d by 1786. During the following decade the daily wages of hewers rose by 25 per cent and material costs by a greater amount, with timber more than doubling its price. The rise in the price of fodder crops also continued to increase, with oats at 16s 3d in 1797 rising to 39s 4d per quarter in 1800.

Wage rates rose at the Earl of Scarbrough's Lumley Colliery where colliers gained an extra 3d per score by the end of 1779, whilst the Middleton Colliery workers were again on strike in January 1787 for higher wages. In 1800 William Stobart, viewer to the Lumley Colliery, wrote that wage rates had considerably increased and 'earnest' money had reached 12 to 15 guineas. John Hardy of Bradford, in evidence to a Parliamentary Committee investigating the state of the coal trade in 1800, stated that a rise in coal prices in Lancashire and Yorkshire was due to an increase in demand and wages. B.R. Mitchell and P. Deane, Abstract of British Historical Statistics, (Cambridge, 1962), p. 488. A. J. Taylor, 'The Sub-contract System in the British Coal Industry', Chapter IX, in L.S. Pressnell (ed.), Studies in the Industrial Revolution (1960), pp. 227 - 8.

Beastall, op. cit., pp. 43-4. Reports from Committees of the House of Commons, first series, Volume X,1785-1801, Reports from Committees on the Coal Trade 1800, p. 566.

(41) A.C.M. S214, S.C.L.

(42) A.C.M. S214, S.C.L.

(43) A.C.M. S274, S207, S.C.L.

(44) The average cost of drawing water from the Attercliffe Colliery 1776 - 1801 was upwards of £2,000 per annum, A.C.M. S214, S.C.L.

Appendix XIX

The Middleton Colliery experienced a rapid increase in average costs per ton of 45s 6d in 1791 to 69s 6d in 1800, with a fall in coal sales from 73,349 to 61,318 tons. Rimmer, op. cit., Appendix I and II.

(45) A.C.M. S214, S.C.L.

(46) LD 387, S.C.L. John Bowden's Counterpart Lease of the Sheffield Colliery, 29 September, 1737.

(47) A 16-peck corf held 4 bushels or 140 lbs of coal. A 'ten' was 44 cart-loads or 30 tons avoirdupois. Each waggon load held 42½ cwt avoirdupois. Hott, "Tramroads of the Eighteenth Century", 4.

A Colliery Report of the Sheffield Park Colliery (Wood Pits) 1775 states that up to this date, 10-peck corves were being used. Thus the calculations made prior to this date have been based on 10 pecks = 87.5 lbs. A.C.M. S215, S.C.L.

(48) The production figures have been calculated at 6 cwts per corf and 5 corves per waggon at the Sheffield Park Colliery. If the same figures are taken for the smaller Manor Colliery the rise in coal sales was dramatic: 1781-1788 at 11,445 tons average per annum, 1794-1801 average production was 18,227 tons. There is some doubt on whether the corf size at the Manor Colliery was the same as those of the Sheffield Park Colliery

(49) Appendix XVII and IV.

(50) Ashton and Sykes, op. cit., p. 42.

(51) Prior to 1758, Bowden paid an annual rent of £400 plus one-fifth of all coal worked in excess of the rent. If the lease had been continued between 1758 and 1765 the Duke of Norfolk would have receive £2,800 annual rent plus one-fifth of £18,538, to produce a total income of £3,148. A.C.M., S195, S.C.L. Corby, op. cit., 1.

(52) The output of the collieries declined from 158,100 corves in 1762/3 to 150,700 corves in 1764/5 with a rise in respective costs of £1,494 9s 10½d to £1,614 17s 4d, and a fall in the balances from £1,205 13s 0d to £1,165 2s 7d. The lessees worked the Gleadless Colliery from 1777 at a rental of £50 per annum. A.C.M. S195B,S177, S.C.L.

(53) A.C.M. S214, S.C.L.

(54) The Attercliffe Colliery rental was £500 per annum whilst the average cost of wood between 1789 and 1794 amounted to £337 per annum. The balance at the Attercliffe Colliery in 1793/4 does not show the rent of wood. At the Sheffield Park and Manor Collieries, the total balance was made up of land rent £100, colliery rent £700, wood, and profit and interest of monies expended with the average cost of wood between 1789 and 1794 at £319 per annum. Appendix XIX.

(55) A.C.M. S214, S.C.L.

(56) The Duke of Norfolk received £13,500 between 1804 and 1805, and a further £500 in 1807/8, although £1,500 of this sum included rent due on the old lease and money due from Vincent Eyre when Treasurer to the Commission of the new market. A.C.M., S205, S185, S.C.L.

(57) A.C.M. S185, S.C.L. In calculation of these figures the balances of the collieries under direct management, after the deduction of wood used, have been added to the total revenue of the Sheffield estate.

(58) Observations on the Gleadless Colliery, by John Stephenson, June 1781, A.C.M. S220, S.C.L.

(59) G. Mee, Aristocratic Enterprise (Glasgow, 1975), p. 87.

(60) Mingay, op. cit., p. 201.

(61) The Swallow family had long been associated with coal and iron in

South Yorkshire. Richard Swallow took over the affairs of John Fell when the former died in 1762, and his widow later left him a fortune of £100,000. Richard Swallow converted the ironworks at Chapeltown and Attercliffe to the production of steel and iron. By 1794 Swallow was leasing Wardsend Forge, Wadsley Bridge Forge, and a Tilt near Sheffield. His son by the same name carried on the business after his death in March 1801. Richard Swallow II established an ironworks at "Swallow Hill" near Barnsley and by 1806 his combined production of pig iron amounted to 3,337 tons, to become the second largest producer of iron and steel in Yorkshire. The Chapeltown concerns of Richard Swallow was an early example of an integrated iron and coal concern that became common in the nineteenth century. The business empire of Richard Swallow did not last long into the nineteenth century, for on 12th July, 1800, his bankruptcy was announced. D. Hey, "The Ironworks at Chapeltown", Transactions of the Hunter Archaeological Society, Volume 10, (1977), 255 - 6.

Richard Swallow was to pay a rental per annum for the three coal seams as follows:

2 acres of Thick Coal - £220
2 acres of Thin Coal - £ 80
2 acres of Bromley Coal - £ 80

The rent per annum for the three ironstone beds known as the Black Mine, White Mine and Gallery Bottom was to be paid at the rate of £212 10s 0d for each one acre one rood. These rents were to be paid whether the quantity of coal and ironstone was extracted or not. If quantities above these amounts were extracted, the rates applied to the surplus was to be: £110 per acre of Thick Coal; £40 per acre of Thin Coal; £40 per acre of Bromley Coal, and £170 per acre of ironstone or in proportion according to parts of an acre worked.

M.D. 1746 - 12, A.C.M., SDS, S.C.L.

The assignees of Richard Swallow paid £1,777 10s 0d in 1811 for the

previous three years' fixed rent. In 1814 the Hesley Colliery worked by Darwin & Co. paid £1,073 15s 0d although the average rent was £590.

A.C.M. S231, S185, S.C.L.

(62) Vincent Eyre, the Duke of Norfolk's land agent and co-partner in the Norfolk Collieries, died in March 1801 leaving his colliery interests to his widow Catherine and brother Thomas Eyre. His position as land agent was taken over by his son, also called Vincent Eyre.

A.C.M. SD9a, 9b, 10, S205, S.C.L.

(63) The lease granted by Thomas and Catherine Eyre to Messrs Sorby & Co. stated they had to fulfil the terms of the previous leases made between the Duke of Norfolk and the Eyres on 2 May, 1805, the Spencer's lease of coal on Attercliffe Common granted in 1798, Earl Fitzwilliam's lease at High Hoole on 15 July 1786 now the property of the Duke, and to uphold the lease made on 25 March 1801 for the Dore House Colliery and the Ballifield coal. Messrs Sorby & Co. were to pay the annual rent of £750 for 18 acres and hold the collieries for 15 years from 25 March 1805. The £72,500 paid for the collieries was divided evenly between the Duke of Norfolk and Thomas and Catherine Eyre.

A.C.M. 65344, S185, S.C.L.

(64) The profits as distributed to the partners in 1817/1818

				£	s	d
William Littlewood	–	8 shares	–	2,484	14	1
John Sorby	–	4 shares	–	1,242	7	1
John Jeffcock	–	5 shares	–	1,552	18	9
Edwin Sorby	–	1 share	–	310	11	9
		TOTAL	–	£5,590	11	8

Profits distributed to the partners 1817/1818 - 1825

1817/1818	£5,590	11	8
1818/1819	5,669	2	3
1819 - 21	1,339	18	10
1821 - 23	8,624	19	11
1823 - 25	1,749	18	4
June 1825 - August 1825	1,156	1	7

Charles Nixon withdrew from the partnership soon after its formation.

MD 3628, S.C.L.

(65) The Sheffield Colliery worked a 5 foot 7 inches coal seam and retrieved 8,106 tons per acre or nine-tenths of the total. The Handsworth Colliery produced 5,436 tons per acre from a seam varying between 3 ft 6 in to 4 ft thick. The Number 2 Deep Pit of the Sheffield Colliery in 1817 produced about 170 waggons of coal weekly. A waggon of hard coal weighed 50 cwts and small - 52½ cwts. Thus a minimum of 425 tons of coal was extracted weekly. A.C.M. S226, S199, S200, MD 3629, 1746, S.C.L.

The Woodthorpe Colliery appears to have taken over from the Manor Colliery. (both worked the Manor Bed/ Parkgate Seam) sometime after 1805. In 1823 a larger colliery was opened which took the name of the Manor Colliery

(66) A.C.M., S226, SD 9a, S235, S.C.L.

(67) A.C.M., S226, S227, S228, S.C.L.

(68) A.C.M., S226, S227, S.C.L.

(69) A.C.M., S235, S.C.L.

(70) A further lease was granted on 31 August 1824 for the remaining 17 years of the original lease which contained similar clauses, except that Bartholomew Hounsfield of Sheffield, merchant, was replaced by Thomas Holy. Some of the previous lessees or their executors and managers were still connected with the company. The proprietors took the name of the Sheffield Coal Company. The accounts were signed by Henry Hartop, Samuel Lucas, John Sorby, Matthew Habershon, Thomas Creswick, Thomas Dunn, Lowe, Edwin Sorby. MD 3628, A.C.M. SD14, S.C.L.

(71) A.C.M., S235, S.C.L.

(72) A.C.M., S246, S235, S.C.L.

(73) In addition, the Marquis - by 1756 - had taken 'in hand' the Elsecar, Swinton Common and Braithwaite collieries, with the latter colliery purchased from William Asline for £115 in September, 1754, and included Braithwaite Close, the colliery, utensils and stock. The Swinton Common and Braithwaite Collieries appear to have been discontinued shortly afterwards, as no further reference is made to them in the accounts. W.W.M. A227, A228, S.C.L.

(74) W.W.M. F96/1, 96/8, S.C.L.

(75) Thomas Smith appears to have been the overseer appointed in 1752 for

the Elsecar Colliery. Fairbanks Collection (hereafter F.B.), 12, W.W.M. R222 (F), S.C.L.

(76) The Kilnhurst Colliery was taken over by Thomas Wainwright in 1774/5, and when the lease expired in 1778 John Thwaites renewed the lease paying £55 per acre, until he gave up the colliery in 1783/4.

W.W.M. A257, A267, S.C.L.

(77) On the distillation of 'oil' the Marquis of Rockingham wrote:

Low-wood Coal	1st Exp.	Cortworth Coal
112 lb		112 lb
About 70 lb of coke		71 lb of coke
2 gallons of water & oil		3 gallons of water and oil
Contained about 2 quarts of oil		Supposed to contain a gallon of oil
Worked - 24 hours		Worked - 24 hours

W.W.M., R175, S.C.L.

(78) W.W.M., F70, S.C.L.

(79) The Bolsterstone Glassworks was worked by George Fox, whose daughter married William Fenney, the works manager. On the death of his mother-in-law, the works were bequeathed to her son, John Fox, who passed them to his grandson, Michael, in 1757. William Fenney, being unable to set up a glassworks 'within 10 miles of the Bolsterstone Glasshouse', according to the terms of his mother-in-law's will, set up his works at Catcliffe near Sheffield in 1740. The Bolsterstone Glasshouse was converted to a pottery in 1778. G.D. Lewis, The South Yorkshire Glass Industry (Sheffield, 1973), p.4.

W.W.M. A221, S.C.L.

(80) W.W.M. A221, A244, A272, Sch.

(81) The total coal sales at the Elsecar Colliery in 1754 was 693 pit loads 26 pulls, out of which 108 pit loads 2 pulls were sent to Kilnhurst, with 60 pit loads 9 pulls for the use of the Marquis at Wentworth.

W.W.M. F96, S.C.L.

(82) Employees at the Elsecar Colliery, January 1769

1. Edward Dickinson, hewer - paid 2s per pit load.
2. John Copley, hewer - paid 2s per pit load.
3. John Knight, filler - paid 6d per pit load.
4. Robert Beaumont, barrower - paid 4d per pit load.
5. Robert Watson, striking the coals - paid 12d per day.
6. Joseph Watson, driving the gin - paid 5d per day.
7. Michael Hague, stacking the coals - paid 15d per day.
8. Joseph Hague, overseer.

W.W.M. F98, S.C.L.

(83) The eight bassett pits consisted of three air pits, one pit not open, two open pits, one working, and one sinking pit. On the deep level were the 'Old Cross Pit', 'New Sough Pit' and the 'Pit on the Throw'. FB12, W.W.M., F70, F97, F100, S.C.L.

(84) Ashton and Sykes, on. cit., pp. 12 - 13.

(85) W.W.M. F98, S.C.L.

(86) In the February/March 1769 Elsecar Colliery accounts a 'Coal Feast' costing £2 1s 1½d was provided. The 'Feast' included malt, hops, beef, veal, bread, butter, tobacco and pipes. W.W.M. F98, S.C.L.

Christmas boxes provided in 1753:

Carrhouse colliers	10s	6d
Lowwood colliers	5s	0d
Elsecar colliers	2s	6d
Cortwood colliers	2s	6d
Westwood colliers	2s	6d

W.W.M. A224, S.C.L.

(87) At the Lowwood Colliery, the wage costs for 'getting' amounted to 15½d, whilst at the Elsecar Colliery it was 12d per dozen in 1767. In addition to hewers, the Lowwood Colliery would also have employed fillers, barrowers, stackers and an overseer. G.G. Hopkinson has stated that in 1763 some 22 colliers worked at Lowwood and eight at the Elsecar Colliery. G.G. Hopkinson, "The Development of the South Yorkshire and North Derbyshire Coalfield, 1500-1775", Transactions of the Hunter Archaeological Society, Volume VII (1951-7), 312, W.W.M. F.70, S.C.L.

(88) This would refer only to hewers, not their assistants. W.W.M. F70, S.C.L.

(89) The horse-drawn gin was put to work 15 July 1754. The second horse may

have been purchased to haul the sledges across the pit yard to the coal hill, as shown on an illustration by Joshua Biram in 1793 of the Elsecar Colliery. The cost of the 'Brown Mare' amounted to £5 15s 0d with the colliers allowed 2s 6d to let the animal down the pit. It seems probable that July 1769 marked the date when a horse was let down Lowwood Colliery, when a separate 'Horse Keeping' account was started. ←——————→ W.W.M. F95, F99, MP55, S.C.L. A.K. Clayton supports H. Saul's contention that a Newcomen engine was at work in the Elsecar Colliery in 1742 but later removed to a lower level. The site of the 'Old Engine Pit' shown on Fairbank's map of 1757 is referred to as the engine's location. However, it is doubtful that such a high cost unit of equipment was ever installed in such a small profit-making colliery, whilst the 'Old Engine Pit' could refer to a horse-driven gin adapted to raise water. A.K. Clayton, Study of the Parliamentary Enclosure in Hoyland (Typescript, 1957), p. 281, S.C.L. quotes from H.B. Saul, "Outcrop Water in the South Yorkshire Coalfield", Transactions of the Institute of Mining Engineers, Volume XCIII (1934), 74, 78, 86.

(90) Messrs Fentons' tonnage calculated on a Parkgate waggon of 85 cubic feet when 81 cubic feet was equal to 42 cwt. Even by 1779/1780 when shipments of their coal down the River Don had declined to 36,126 tons, Lowwood output in 1781 had only reached 17,170 tons and at Elsecar in 1780 to 3,001 tons. W.W.M. R174, R222, F70, S.C.L. Appendix VI.

(91) W.W.M. A267, S.C.L.

(92) The total rental thereafter was to be £500 per annum. The Basingthorpe Colliery rent of £500 accounted for most of the total canal revenue, for example in 1784/5 the total receipts amounted to £516 2s 6d. W.W.M. A272, A273, S.C.L.

(93) Messrs Fentons were allowed to extract 18,500 waggon loads per annum, working seven acres per year at 2,613 waggons per acre. The profit was calculated at £618 18s 7½d per acre to give £4,326 0s 0d on seven acres, leaving the lessees - after deducting £2,300 0s 0d colliery

rent and £500 canal rent - £1,526 0s 0d clear profit.

W.W.M. F70/66 S.C.L.

(94) W.W.M. St. P.3, S.C.L.

(95) Mee, op. cit., pp. 78-80.

(96) John Stephenson's remarks regarding Southwell and Lowwood collieries, 1790. W.W.M., F70, S.C.L.

(97) W.W.M. F100/10, S.C.L.

(98) G. Mee implied that Michael Hague resigned when John Deakin was appointed over him, when in fact they worked together for some 4 years. The resignation of Michael Hague did not take place until the Elsecar New Colliery had been opened for over a year. Deakin appears to have been employed specifically to supervise the construction of the Elsecar New Colliery as his duties commenced in December 1793 - not as G. Mee states in 1797. The Household Accounts Record in 1796:

"Mr John Deakin for three years' salary for inspecting and directing the working and management of the Collieries to Christmas 1796 ..... £189 0s 0d"

Mee, op. cit., p. 96, W.W.M. A54, S.C.L.

(99) A separate account for sinking the Elsecar New Colliery was opened in the Household Accounts, with John Hague and Richard Watson being paid £12 17s 0d on 12 April, 1793, for boring to find the direction of a 'throw'. The colliery was sited where the second bore-hole was sunk in 1790. W.W.M. A50, S.C.L.

(100) John Curr gave the cost of a 40-inch diameter cylinder pumping engine in 1797 at £827 with £604 for sinking an engine pit 30 fathoms in depth. A. Clayton has written that the following parts were supplied to build the engine:

	£ s d
Longden & Co	325 6 10
Darwin & Co	581 13 7
Booth & Co	153 18 6
	£1,060 18 11

The Elsecar engine had a 42-inch diameter cylinder when installed and commenced working in September, 1795.

A.K.Clayton,"The Newcomen-Type Engine at Elsecar, West Riding", Transactions of the Newcomen Society, Volume XXXV (1962-63), 104-7.

Curr, op. cit., p. 95. — W.W.M. — A52, S.C.L.

(101) W.W.M. F71 Downs-Fitzwilliam, 24 November 1795, S.C.L.

(102) As this was a new colliery, the major proportion of the expenditure would have been on new capital equipment. W.W.M. A54-74, S.C.L.

(103) This method of emptying corves was probably the same as introduced by John Curr into the Norfolk collieries.

W.W.M. St.P.,13, 7 March - Memorandum Mr Deakin's Orders, S.C.L.

(104) The local ironworks specialised in waggon rails, corf wheels and engine parts. Appendix VIII.

(105) W.W.M. St. P. 6 (iv), S.C.L.

(106) Buildings built, converted or repaired for the collieries 1797-8:

4 new houses at Skiers Hall

4 old houses repaired at Skiers Hall

4 houses made from a tithe barn

10 new houses at Elsecar

10 new houses in 'Ing Close'

10 houses in 'House Ing' - (probably repaired)

W.W.M. A57, 58, iii, S.C.L.

(107) The Brampton Colliery changed its name to the Rainbow Park Colliery in 1821.

(108) W.W.M. A101, A103, A109, A115, S.C.L. Appendix XIV.

(109) Appendix VIII

(110) Expenses of the Great Engine, New Park Gate Colliery:

	£	s	d
The Coalbrook-Dale Company for castings	830	15	0
The late Jona Woodhouse, Engineer, for planning etc ..	62	12	6
George H. Darrow, for castings	227	1	11
Newton Scott & Co " "	67	8	1
Hartop Sorby & Co " "	98	19	3
Josiah Parkes & Son for applying the smoke-consuming apparatus	89	0	0
Samuel Sykes for building the Engine House chimney etc	503	11	0
James Wain, for erecting the engine	258	1	0
	£2,157	8	9

W.W.M. F70/105, S.C.L.

Fitzwilliam's concern for reducing atmospheric pollution is seen by the expenditure of £89 0s 0d on smoke-consuming apparatus, presumably to reduce the possibility of smoke being seen from the Park and Wentworth Woodhouse.

(111) Mee, op. cit., p. 24, W.W.M. F105a, F106/56, S.C.L.

(112) W.W.M. A283. A70, S.C.L.

Purchase of the Cortworth Colliery:

	£	s	d
Utensils, materials, etc	456	6	4
Hay, eddish	98	8	10
Pits sunk and open	196	17	6
Annuity on the colliery	150	0	0
Tillage, etc	25	8	5
	£905	1	1

W.W.M. A72, S.C.L.

(113) The Purchase of Freeholders' Coal:

1. William Gray coal grant 29 September 1799, purchase money £2.700 1s 6d paid in 21 annual instalments of £128 11s 6d. First payment made 5 April 1800 and last one due 5 April 1820. Grant for 99 years provided coal not extracted sooner.

2. Mr Wigfield's coal grant: Purchase money £4,200 by 21 annual instalments of £200 commencing 5 April 1800 to 5 April 1820.

3. Mr Stanton's coal grant 25 November 1804; Purchase money £3665 12s 0d of which £800 paid down, £200 on 6 April 1805 and remaining £2665 12s 0d in 16 annual instalments of £166 12s 0d to 6 April 1821; for 99 years if coal not extracted sooner.

4. Captain Allen's coal grant 5 April 1803; price being an annuity of £350 during his life; no time-limit for working the coal.

5. Messrs Hoyland's coal grant 11 November 1811; purchase money £1,972 10s 0d in seven annual instalments of £281 15s 0d to 11 November 1818. No time-limit in working the coal.

6. The Southwell lease dated 5 December 1810 for 21 years: annual rent £50 and £160 per acre over stipulated quantity of 3 roods.

W.W.M. F100/25, S.C.L.

(114) W.W.M. F70/27, S.C.L.

(115) W.W.M. F70/41. Letter D. Hall to Earl Fitzwilliam, 24 January 1784, S.C.L. The Southwell Colliery was leased from the Southwell Minster in Nottinghamshire.

(116) W.W.M. F107(f). Letter J. Biram to Earl Fitzwilliam, 3 January 1812, S.C.L.

(117) The Haugh Colliery only employed 24 workers and being a small undertaking, had little capital equipment. It consisted of two pits and supplied the ironworks in Sheffield, Masbrough and Brightside. W.W.M. F107, S.C.L.

(118) Appendix XVI

(119) The colliery 'balances' and 'net profit' have been added to the revenue of the Wentworth estate in the calculation of the percentages on page 81. This is because the revenues of the Wentworth estate as recorded in the 'Estate Account Books' and shown in Appendix XXV, XXVI, do not include the colliery 'balance' or 'net profit' of the collieries under direct management. Appendix XXV, XXVI.

W.W.M. PIOZ, S.C.E.

(119) The colliery 'balances' and 'net profit' have been added to the revenue of the Wentworth estate in the calculation of the percentages on page 81. This is because the revenue of the Wentworth entails as recorded in the 'Estate Account Books' and shown in Appendix XLV, XXXI, do not include the colliery 'balance' or 'net profit' of the collieries under direct management. Appendix XLV, XXVI.

CHAPTER FOUR

(1) By the end of the eighteenth century hewers in the Northumberland and Durham Coalfield were paid 5s a fathom, which increased by 5s a fathom for every additional 5 fathoms. Sinkers at the Griff Colliery received 2s 6d an ell (45 inches) for the first 4, 3s 0d for the next 4, and 3s 6d for the following 4 ells. T.S. Ashton and J. Sykes, The Coal Industry of the Eighteenth Century (Manchester, 1929), pp. 15 - 16.

(2) In 1749, the Berwickston Colliery near Berwick left coal pillars 8 - 10 feet thick and 18 feet in length. It was common practice in many collieries to 'rob' the pillars as the workings were abandoned. Thomas Barnes at the Walker Colliery on the Tyne introduced the panel system in 1795. The colliery was divided into sections of 10 - 20 acres in area, and around each a wall of stone or waste was constructed some 40-50 yards thick. This method of working allowed the removal of half every second pillar and increased by one-quarter the output of coal; whilst the old workings could later be sealed off to prevent the escape of gas. Ashton and Sykes, op. cit., pp. 17 - 18.

(3) During the 1760's the Duke of Bridgewater brought Shropshire miners to work in his Worsley Collieries - ibid., p. 28.

The extraction of such a large proportion of the coal increased the possibility of surface subsidence, and as a consequence could not be used under buildings or property susceptible to earth movement. At the Sheffield Park Colliery in the 1780's, for example, regular payments were made for damage to farmers' land, and on 12 March 1632 the Norfolk lessees were advised to leave 5 acres 6 perches of coal under the Sheffield and Tinsley Canal and its branch. A.C.L., S190, S233, S.C.L.

(4) T. S. Ashton, An Economic History of England: The Eighteenth Century (1929), p. 121. In the East Midland Coalfield a price per ton was fixed between the manager and the butty who hired the other workers such as hewers, hurriers and hangers-on. A.R. Griffin, Mining in the East Midlands, 1550 - 1947 (1971), p. 29.

(5) Fig. XIII

(6) D. Anderson, The Orrell Coalfield, Lancashire, 1740-1850 (Buxton, 1975), p. 71. In the East Midlands Coalfield, Sir John Molyneux drove a cough in 1703 that ran eventually for 5 miles by 1774. Griffin, on. cit., p. 5.

(7) A 5-inch diameter pump driven at 200 feet per minute could lift 10,200 gallons per hour from 80 feet, with eight horses to work the rag and chain pump. Water-wheels were also used to drive colliery pumps, such as the one at Aspell in the Orrell Coalfield that could raise 5,760 gallons per hour from 58 yards with bucket pumps, in 1746. This method relied on a constant supply of water. Although no evidence has been found of the use of water-wheels to drain the Norfolk collieries, they were employed to raise coal. Anderson, on.cit., pp. 79,81.

(8) R.L. Galloway, Annals of Coal Mining and the Coal Trade, Volume 1 (Newton Abbot, 1971), pp. 237,239. The first commercial engine was erected near Dudley Castle in 1712, with a 21-inch diameter brass cylinder that raised water in two lifts from 153 feet.

(9) ibid., pp. 239, 241.

(10) The early cylinders and specialist parts were made at the Coalbrookdale Works of Abraham Darby, but the general castings were often contracted out to local ironmasters. This monopoly was eventually broken when other ironmasters became more proficient in the production of precision goods - such as Booth, Binks and Hartop of Sheffield who supplied the engines for the Attercliffe Colliery between 1787 and 1790. A.C.M. S201, S.C.L.

Although there was a 'Fire Engine' at Bowden's Greasbrough Colliery in 1764, there was probably one at the colliery much earlier. This tends to be borne out in 1735 when the Earl of Malton granted a lease to William Spencer to mine coal in Greasbrough, with instructions to erect a 'fire engine' to lift the water at least 70 yards from the bottom of

the coal to a sough, which had previously been driven to the River Don. The colliery was taken over by Bowden on the expiry of Spencer's lease in 1742, and he in turn relinquished the concern to Rockingham on payment of £600 in 1764. On surrender of the lease, Bowden was asked to fill in the pits except the one where the 'fire engine' near Cave House was placed. This engine was probably the first in South Yorkshire, for Dickinson's map of 1750 shows a single engine in the area. W.W.M. D 1727, 170, M.B.C. 300, S.C.L. G. G. Hopkinson, 'The Development of Lead Mining and of the Coal and Iron Industries in North Derbyshire and South Yorkshire, 1700-1850' (unpublished M.A. thesis, University of Sheffield, 1950), p. 272.

(11) At Lord Dudley's pits in Netherton, Staffordshire, a lighted candle was drawn on a trolley to ignite the gas, three times a day - so abundant was the gas. Ashton and Sykes, on. cit., p. 42.

(12) A vertical shaft was sunk on the rise of the colliery with a drift further down the hillside. As the air density in summer is higher outside the colliery than in the workings, fresh air entered by the vertical shaft and passed out through the drift - a process that was reversed in winter.

(13) Charles Spedding, around 1740, invented the steel flint mill, whereby a steel disc revolving against a flint produced a shower of sparks by which the miner worked. However, it did not prevent explosions and required a person to work it full-time.

(14) Ashton and Sykes, on. cit., p. 61.

(15) In the Orrell Coalfield, coal was filled into baskets holding 122 lb in the Orrell Hall Colliery, and 140 lb at the Dean Colliery, in 1740. The baskets were dragged by children to the pit bottom on sledges fitted with metal runners. Baskets at the Hulton Pits near Bolton measured 31 inches x 21½ inches and 8 inches deep, holding 1½ cwt. Anderson, on.cit., pp. 62-3, Galloway, on.cit., p. 253, Ashton and Sykes, on. cit., p. 19.

(16) The Curghey House Pit of Sir Roger Bradshaugh in 1746, worked a whim gin with four horses, and at the Whitehaven Colliery in 1801, four horses hauled coal from a depth of 100 fathoms at the rate of 42 - 44 tons in nine hours, in three hour relays. Michael Menzies' water-pulling machine was worked by a descending drum of water that assisted the upward movement of the corf. A major drawback was that it required a waterfall of about half the depth of the pit. Ashton and Sykes, op. cit., pp. 56 - 7. J. Curr, The Coal Viewer and Engine Builders' Practical Companion (Sheffield, 1797), pp. 33 - 4

(17) Galloway, op.cit., p. 297. Curr, op. cit., p. 34.

(18) The longwall system of mining appears not to have been thought suitable for the working of the Attercliffe Colliery. Prior to 1800 the hewers were individually recorded, a practice familiar to the pillar and stall mode of working. However, by 1814 a system similar to longwall mining had been introduced at the re-named Handsworth Colliery. A.C.M. S215, S226, MD 1746, 3629, S.C.L. See fig. XII. A. Raistrick, (ed.), The Hatchett Diary: A Tour Through the Counties of England and Scotland in 1796 Visiting Mines and Manufactories (Truro, 1967), pp. 71 - 2.

(19) In two banks were 'Jnr Elliot, William and Thos, Elliot' and 'Thos. Jnr and Jos. Leversidge'. The Finchwell Pit, 74 yards in depth, worked banks whose average length was 46 yards. Two of the companies paid for a filler at 17s and 19s per week. MD 3629, S.C.L.

(20) The levels measured 1 yard high and 1½ yards wide at the bottom, whilst the horse-gates were 4 feet wide at the top and 3 feet wide at the bottom. MD 3629, S.C.L.

In the Woodthorpe Colliery's Boundary Pit in 1818, the Parkgate Seam, 5 feet 4½ inches thick, was worked at a depth of 41 yards. The level 'is or should be' 3 feet 9 inches at the bottom and 3 feet at the top, with the boardgates 7 feet wide and driven at the rate of 1s 6d per yard. At the bottom they were paid only 2s per yard for 4 yards, 1s 6d per yard for the next 3 yards and nothing for the remainder, as the face there was 4 yards wide. The colliers were paid at 3s 3d per

waggon of 14 corves and 1s for every 20 punches as wood money and keeping the banks in good condition. MD 3629, S.C.L.

(21) In the early 1780's the pits were given names such as Black's, Barn's, and Newton's Pits, although later they were referred to by number. When the collieries again came under lessees, the pits reverted to being called after the company leader.

The Sheffield Park Colliery accounts for 1793 give the following companies and their wages 27 April - 4 May:

Number of Pit	Company	Wage £	s	d
No. 5	Elliott & Co	1	3	9
	Eyre & Co	2	11	9½
No. 6	Holmes & Co	2	15	8
	Roper & Co			
No. 7	Lindley & Co	1	6	1
	Newton & Co	4	15	3
No. 8	Thos. Barns & Co	3	14	4½
	L. Barns & Co	6	9	11½
	Jos. Barns & Co	2	18	6
	Black's & Co	4	4	9½
Short Work	Tomlinson & Co	4	10	5
	Wild & Co	5	14	11
Heading	Hathouse & Co	3	14	9
	Worrall & Co	1	7	8
	Newton & Co	3	0	2
	Barns & Co	2	17	6

A.C.M. S199, S.C.L.

(22) Griffin, op. cit., p. 29.

(23) In the week 29 August - 5 September 1789, Roads & Co were paid - 40 yards at 3s 4d, 22 yards at 2s 2d; How's & Co - 44 yards at 2s 10d, 21 yards at 2s; Worral's Co - 45 yards at 2s 0d and 25 yards at 2s. A.C.M. S198, S.C.L.

(24) Anderson, op. cit., pp. 58-9, A.C.M. S201, S.C.L.

(25) S. Pollard, The Genesis of Modern Management: A Study of the Industrial Revolution in Great Britain (1965), p. 65. M.D. 3629, S.C.L. Appendix IX.

(26) Curr, op. cit., pp. 94-5, A.C.M. S201, S215, S222, S.C.L. Fig. VII. A further estimate was made for a colliery in Matthewman's Croft near

the Ponds at £2,000, to drain 139 acres of coal. A.C.M. S223, S.C.L.

(27) Curr, op. cit., p. 37.

(28) ibid., pp. 37 - 41, Fig. VII.

(29) T.W. Beastall, A North Country Estate: The Lumleys and Saundersons as Landowners, 1600 - 1900 (Chichester, 1975), p. 32.

(29a) A.C.M. S214, S274, S.C.L. - Curr wrote that the expenses of the Attercliffe Colliery engines in the eight weeks preceding 22 February 1800 were £593 14s 1d and for the year as a whole £3,000. In the case for trespass against a Mr Staniforth, it stated that around 1799 four pumping engines worked at the Attercliffe Colliery at an expense of £5 - 6,000 per annum.

(30) A.C.M. S215, S198, S.C.L. Curr, op. cit., p. 31.

(31) Raistrick (ed.), op. cit., pp. 71 - 2.

(32) A.C.M..S205, S.C.L.

(33) The corves were probably still in use during the 1780's, as the accounts show several payments for 'women whickering'. In reference to the basket or twig corf used in the Newcastle and Sunderland areas, Curr wrote that they were suitable for small coals due to their ' . . . globular form with a small aperture at the top but unsuitable further south where the coal was carried to market in large pieces.' A.C.M. S215, S198, S.C.L.

(34) The corves were hauled along tramways by horses rather than by boys. Ashton and Sykes, op. cit., p. 64.

(35) The corves had an iron framework with wooden sides and bottom, and ran on four metal wheels. Those used in the 'longway' mode of working weighed, when empty, about 3 cwt and 5½ - 6 cwt when filled. Its dimensions were - 40 inches long, 30 inches wide, 21½ inches high and 30 inches high on its wheels. The 'short work' corf measured 42½ inches long, 31½ inches wide, 19 inches high,

and 26 inches high on its wheels. Under the 'longway' system the banks were narrow and the coal mainly small, whilst the 'short work' system was adopted in thin seams and produced large coals. Curr, op. cit., pp. 15-22, Fig. VIII. A.C.M. S232, S.C.L.

(36) A.C.M. S223, S214, S.C.L. Raistrick (ed.), op. cit., pp. 71 - 6. Curr, op. cit., p. 9.

(37) B. F. Duckham, A History of the Scottish Coal Industry. A Social and Industrial History, Volume 1, 1700-1815 (Newton Abbot), p. 103.

(see over)

(38) A. Raistrick, Dynasty of Iron Founders: The Darbys and Coalbrookdale (Newton Abbot, 1970), p. 181.

(39) Curr's 'Common Plate' for general use was 6 feet long, 3 inches broad on the 'trod' and ¾ inch thick. The flange stood 2 inches above the plate and was 2 inches thick where it joined, tapering to 3/8 inches. The total weight of the plate amounted to 47 - 50 lbs; nail holes were made within 1 inch from each end. Sleepers to support the rails were 3 feet 4 inches long for a wide corf, and 3 feet 2½ inches wide for a 'straitor one'. Sleepers made of oak were recommended and sawn 4½ or 5 inches broad by 2½ inches thick, with the plates sunk 1 inch deep into the sleepers. The rail-road was to be laid down 22½ inches wide for narrow corves and 24 inches for the wider corves.

Curr, op. cit., pp. 23, 30. Fig. IX

(40) A.C.M. S214, S.C.L.

(41) A. Raistrick (ed.), Hatchett Diary, pp. 70 - 1.

(42) Curr, op. cit., p. 14.

(43) B. Trinder, The Darbys of Coalbrookdale (Chichester, 1978), p. 49 - 50.

(44) The technological advances made in the Norfolk collieries can be compared with the Blundell mines in the Orrell Coalfield in 1841. They were still using baskets placed on trams with the basket being hauled up the shaft. D. Anderson thought it unlikely that tubs were ever used in the Orrell Coalfield. Anderson, op. cit., p. 63.

(45) A.C.M. S198, S223, S.C.L. Bland Collection 11 - 5 S.C.L.

(46) During March 1794, Curr supplied an engine to raise coal, costing £200 for the Manor Colliery, and another in December 1795 for the Attercliffe Colliery at £370. Curr, op. cit., p. 36, Raistrick (ed), Hatchett Diary, pp. 71 - 2. A.C.M. S199, S202, S232, MD 1746-10 S.C.L.

(47) The patent for Curr's conductors and tipplers was taken out on 12 August 1783 - letter patent No. 1660. Calloway, op. cit., pp. 294, 323.

Ashton and Sykes, op. cit., p. 65, Galloway, op. cit., p. 294, 323. Raistrick (ed.), The Hatchett Diary, pp. 70-1.

(48) Raistrick (ed.), The Hatchett Diary, pp. 70-1, A.C.M. S214, S.C.L.

(49) John Buddle recommended that the schemes be commenced as soon as possible, to overcome any problems, such as the 'obstinacy of workmen', which reflects the unwillingness of colliers to accept innovations. A.C.M. S223, S214, S.C.L.

(50) A.C.M. S214, S.C.L. The patent No. 1924 for this double rope was taken out by Curr in 1792. R.A. Mott, "Tramroads of the Eighteenth Century and Their Originator, John Curr", Transactions of the Newcomen Society, Volume XLII (1969-70), 6.

(51) The flat rope letters patent No. 2270. Mott, op. cit., 6. A.C.M. S214, S.C.L.

(52) MD 1746 - 27, S.C.L.

(53) A.C.M. S215, S.C.L.

(54) A.C.M. S215, S.C.L.

Estimated Cost of the Waggon-way:

	£
10s per yard of oak and beech rails and finishing	
2,000 yards of double rail at 10s	1,000
1,000 yards of branches to several pits at 6s	300
To the coal stage	250
To 15 waggons (with metal tore wheels) at 15s	225
Repairing road from the stage to the foot of Sheer Bridge	125
To agency and contingent charges	100
	£2,000

A.C.M. S217, S.C.L.

(55) The 'medium' price at the pit was 2s 5d per load. A.C.M. S215, S.C.L.

R.A. Mott, Sheffield Telegraph, Newspaper Cuttings, Volume 27 (1933), p. 47 S.C.L. gives hard coal sold at 3s 4d per load, small 2s 2d per load at the pit, with cartage to the town at 2s 4d per load. N.E. Leader,

Sheffield in the Eighteenth Century (Sheffield, 1901), p. 84, 85,- gives hard coal 3s 4d, hard and small 2s 8d and small 2s per load of 8 corves.

The waggon-way started in James Keller's Broad Oak field and ran almost parallel with City Road to a coalyard at the bottom of Park Hill, where Duke Street and South Street joined Broad Street.

(56) A.C.M. S205, S.C.L.

(57) As late as 1778 the Lowood Colliery employed only 12 colliers.

(58) Fentons were allowed to extract the remaining coal after their lease expired in 1818. W.W.M. St.P. 13a, S.C.L. Fig. X

(59) W.W.M. F70, S.C.L.

(60) Ashton and Sykes, op. cit., p. 14. George Norbron & Co (also employed at the Duke of Norfolk's Bosley Wood Colliery) were paid £5 for boring to find coal for the proposed Elsecar New Colliery. However, most of the boring was carried out by Michael Hague Jnr. and John Hague, related to Michael Hague agent for the Elsecar and Lowood collieries. W.W.M. A48, S.C.L. Boring rods were often sent from considerable distances - from Leicester to the Elsecar New Colliery and Northampton-shire to the Westwood Colliery. W.W.M. A48, F97/5, S.C.L.

The agreement was made 8 April 1822 between Joshua Biron, on behalf of Earl Fitzwilliam, and James Hague, William Hague Snr., William Hague Jnr., Joseph Jackson, George Glossop and John Ongreaves. The Rye Pit was to be 70 yards deep with a 9-feet diameter within the stone walling. The initial 20 yards at £1 per yard, the next 20 yards at £1 10s 0d per yard, and the remainder at £2 per yard. W.W.M. St.P. 15(b) S.C.L.

(61) W.W.M. F97/11, St.P. 3 (viii) S.C.L.

(62) W.W.M. St.P. 13 S.C.L. - A comparison of rates between sinking a vertical shaft and drift can be seen in the following

Rates for driving the drift - 11s per yard for the initial 40 yards, 25s per yard for the next 45 yards, 26s per yard for the remaining 45 yards, making 130 yards in all.

Rates for sinking the oval pit on the bassett side of the 'throw'

16s per yard for the initial 16 yards, 22s per yard for the next 16 yards, 28s per yard for the remainder. The work was to be undertaken in double shifts.

(63) F.B. 12, S.C.L.

(64) W.W.M., MF55, MF56, F100/29, S.C.L. Fig. XI

(65) W.W.M. F70/82, S.C.L. Fig. XII

(66) W.W.M. F70/86, S.C.L.

(67) W.W.M. F98/12. In 1769 the colliers were paid £1 12s 0d for removing 32 dozen 'puncheons' at 12d per dozen. W.W.M. C48, S.C.L.

(68) W.W.M. F98/8, S.C.L. The Elsecar Old Colliery employed in 1769 -- 3 hewers, 1 filler, 1 barrower, 1 man landing the coal, 1 stacker, 1 gin driver, 1 man selling the coal and overseeing the work; (a horse-gin was introduced in 1769). Hewers were paid 2s per load, fillers 6d per load, barrowers 4d per load, landing the coals 1s per day, stacking 15d per day (assistant to the overseer), gin driver 5d per day; selling and care of the works 16d per day.
W.W.M. F106/56, F105(a), St.P. 13, S.C.L.

(69) W.W.M. F106/10, S.C.L.

(70) Fitzwilliam Colliery soughs were lined with stone. John Stephenson was the mining engineer at Walker's Kimberworth Park Colliery.
W.W.M. F70 (h), S.C.L.

(71) W.W.M. St. P.3, F.106(e), S.C.L. Mr Steedman of the South Yorkshire Environment Department recalled that in conversation with a miner a 'slusher' was employed to clear the soughs along which they walked, stirring up any deposit with their feet, to be carried away by the flow of water. They worked flexible hours according to the conditions.

(72) W.W.M. F70/91, S.C.L. Joshua Biram used ale gallons (one ale gallon = 0.965 Imperial Standard Gallons). A.K. Clayton, "The Newcomen Type Engine at Elsecar, West Riding", Transactions of the Newcomen Society, volume XXXV (1962-3), 102.

(73) W.W.M. St. P.5(ii), S.C.L.

(74) W.W.M. St.P. 5 (ii): The pumps had been installed by November 1812, and comprised of a 13-inch diameter [illegible] and two 8-inch pumps. They raised water to the Lowood Colliery old sough at the rate of about 626 gallons per minute.

W.W.M. F107(f), February 20, 1812, S.C.L: The Lowood Colliery old sough also took in water from the Elsecar Old Colliery that emptied into the brook near Cobcar Ing (the sough outlet can still be seen). The Elsecar engine reckoned to draw 40 gallons at each stroke, making 13 strokes per minute which, in 24 hours, could draw 748,800 ale gallons (one ale gallon = 0.965 Imperial Standard Gallon) before the installation of the additional pumps. It was thought the new Clough sough would be a suitable feeder for the Morley Hill Dam, and on completion it immediately had an impact on the drainage of Lowood workings. The flow of water from Lowood to Elsecar down the deep level, 16 September 1811, was about 104,582 ale gallons in 24 hours; 7 February 1812 increased to 142,139 ale gallons and 11-19 February to 152,895 ale gallons in every 24 hours. Joshua Biram believed the increase in water came from Michael Hague's Southwell Colliery old workings following heavy rains. W.W.M. F107(f), S.C.L.

(75) W.W.M. A223, S.C.L.

W.W.M. F98/11, S.C.L. An entry in the accounts refers to:

> "By Cash paid to Mr Woodhead, for the hedges, making up where the road was made for the furnace coals ..... 1s 0d"

W.W.M. F98/19, 29 July - 12 August 1769, Elsecar Colliery.

W.W.M. F106(b), S.C.L. The surface gradient of the Lowood Colliery would have favoured natural ventilation.

(76) W.W.M. St.P. 5(i) (ii), S.C.L.

(77) W.W.M. A64 - A72, S.C.L. - Michael Bisby, overseer of the Lowood Colliery retired in 1801 on a pension of 10s 6d per week which lasted for 143 weeks to give a total of £75 1s 6d. Edward Dickinson, a collier,

was given 5s per week for a year in 1805. Several payments of £1 1s 0d were made to colliers hurt by a fall of coals. In December 1802

"William Sellers, Junr. 4 weeks' allowance for loss of time by being scalded in the new sough by the engine boiler being let off ..... £2 2s 0d"

The usual payment to widows was 2s 6d per week. The colliers were also treated by a 'surgeon' paid for by the proprietor.

W.W.M. St.P.4(vi): In 1852 an explosion in the Elsecar New Colliery killed 10 workers after a trap door, left open, cut off the air supply to the work face. When the door was eventually closed, the accumulation of gas was diverted along the face where it ignited on the flame of a lamp whose gauze had been removed. W.W.M. G40, S.C.L. G. Mee Aristocratic Enterprise (Glasgow, 1975), pp. 125-129. N.K. Buxton, The Economic Development of the British Coal Industry (1978), pp. 73, 74, W.W.M. G96, S.C.L.

(78) W.W.M. F106/56, F105(a), St.P. 13, MP55, S.C.L. The shallowness of the Elsecar Colliery (15 yards 1 foot) would have enabled a hand-turned gin to be used.

(79) W.W.M. F95/23, S.C.L. Two horses were purchased.
W.W.M. F98/5, S.C.L.

(80) W.W.M. A54, A58, G96, S.C.L. In 1853 the Elsecar New Colliery had two steam whimseys, Elsecar Old Colliery one 10 h.p. engine, Lowood Colliery one 12 h.p. engine.

(81) W.W.M. St. P. 13, S.C.L.

(82) W.W.M. F107, S.C.L.

(83) Elsecar New Colliery had 2 x 2 corves at 30s each. W.W.M. 696, St.P.13 S.C.L. Hilton and Sykes, op. cit., p. 68.

(84) Appendix XIV.

CHAPTER FIVE

(1) T.S. Ashton and J. Sykes, The Coal Industry of the Eighteenth Century (Manchester, 1929), pp. 5, 12. N.K. Buxton, The Economic Development of the British Coal Industry (1978), pp15, 17.

(2) Ashton and Sykes, op. cit., p.228. A.C.M. S215, MD 1746-27, S.C.L.

(3) D. Anderson, The Orrell Coalfield, Lancashire, 1740-1850 (Buxton, 1975), p. 27.

(4) A. Young, A Six Months' Tour Through the North of England, Volume 1 (1769), pp. 123 - 33.

(5) T.S. Ashton, Economic Fluctuations in England 1700-1800, (Oxford, 1959), p 71

(6) A.D. Gayer, W.W. Rostow, A.J. Schwartz, The Growth and Fluctuation of the British Economy, 1790-1850, Volume 1 (1975), pp 112, 118, 146.

(7) Sheffield Local Register 200 - 1857, Volume 1 (Sheffield, 1830), p. 48, T.S. Ashton, Iron and Steel in the Industrial Revolution (Manchester, 1924), p 47.

(8) A.C.M. S195(b), S C.L.

(9) A.C.M. S185, S.C.L. Ashton, Iron and Steel, p.84.
(9a) A.C.M. S236, S.C.L. Appendix XVII
(10) Ashton, Iron and Steel, p. 150.

(11) ibid., p 160.

(12) W.W.M. F100, S.C.L.

(13) A.C.M. S185, S.C.L.

(14) A.C.M. S215, S.C.L. The Gleadless Colliery was later leased to Townsend and Furniss at £50 per annum. They also leased the Sheffield Park Colliery 1764-1781, working the 4 feet 5½ inch Silkstone Seam (Wood Pit Seam). The first foot of the seam was used as house coal, being unfit for the cutlers on account of the 'white spar' in it. The next 1 foot 3½ inch was used only by the cutlers followed by a 5 inch band with 'Coal-pipe' in it varying between 5 inches and 10 inches was -

> ". . . in working is carefully thrown back and pillared up in the waste."

Lastly the 'Bottom-coal' containing considerable 'White spar' was used on' for house coal.

(15) By the terms of the Act, Brandling had to deliver into Leeds a minimum of 23,000 tons per annum for 60 years. G. Himmer, "Middleton Colliery (1770-1830)", Yorkshire Bulletin of Economic and Social Research, Volume 7, Number 1, (1955), 48-52.

(16) E.D. Leader, Sheffield in the Eighteenth Century, (Sheffield, 1901), p. 84.

(17) "The main reason for their opposition was that they believed improved communications would increase competition in their local markets and cause prices and rents to fall."
G.E. Mingay, English Landed Society in the Eighteenth Century, (1963), p. 196.

(18) J.T. Ward, "West Riding Landowners and Mining in the Nineteenth Century", Yorkshire Bulletin of Economic and Social Research, Volumes 15 - 16, (1963-4), 64.

(19) Osborne, Clay and Smith paid a nominal annual peppercorn rent and £100 for every 2 acres worked and £50 for every extra acre. The Darnall Colliery under lease to Phipps, Clay and Dunkin in 1786, also leased coal under Earl Fitzwilliam's High Hazles Estate in Handsworth at £80 per acre. R.A. Mott, Sheffield Telegraph, Sheffield Newspaper Cuttings, Volume 27, (1933), p. 46, S.C.L. A.C.M. S235, 65344. MD 1746, S.C.L.

(20) Leader, op. cit., p. 84.

(21) A report in 1773 on the Norfolk Collieries stated that the need to repair the Park roads was:

> " . . . an Article of great advantage to them, when compared with the enormous expense of upholding the road to his Grace's colliery, which falls entirely upon the occupiers thereof."
>
> A.C.M. S215, S.C.L.

(22) Canal and road construction reached a peak in 1792-3 and whilst pig iron production rose considerably from 1785, brick production almost doubled over the period.
Gayer, et al., op. cit., pp. 14-38, MD 1746, S.C.L.

(23) A coal lease granted 21 June 1792 was for 110 acres in Handsworth and Rotherham for 80 years to commence on 25 June 1793 at an annual rental of £50 per acre. MD 1746, A.C.M. 65344, S.C.L.

(24) There was a national depression in 1793 at the outbreak of the French Revolutionary Wars. Gayer, et al. on. cit., p 8.

Financial difficulties forced the Dore House Colliery proprietors to form a joint stock company with 1,000 shares, of which 200 were to go to the original proprietors. William Dunn became the manager and a shareholder. MD 1746, MD 1735, A.C.M. S200, S205, S.C.L.
J. Hunter, Hallamshire (Sheffield, 1869), p 172.

(25) A.C.M. S214, S.C.L.

(26) The Duke of Norfolk permitted the construction of a turnpike road through Sheffield Park on condition that his lessees were exempt from paying tolls on coal worked on the Woodthorpe and Gleadless Commons when passing the tollgate at the southern entrance to the Park. The trustees included Earls Fitzwilliam and Manvers, and Newbald, who were colliery proprietors or lessees having an interest in promoting the Bill and reducing the Norfolk dominance of the Sheffield coal market.
A.C.M. S246, S.C.L.

(27) A.C.M. S246, SD 14, 15, S.C.L. In the lease granted by the 12th Duke of Norfolk in 1821 to Holy and Company, the Duke stated he would use his influence to protect the lessees' interest concerning any road through Sheffield Park, if called upon to do so. At a meeting held on 22 February 1821, the Sheffield Park Road trustees expressed regret at the refusal of the lessees to accept a 'half toll' on narrow wheels, thus preventing the co-operation of the Duke. As a consequence the trustees decided to reduce the charge on broad wheels to encourage their use.

(28) The colliery proprietors' reluctance to construct a railroad was probably due, in part, to the fate of the waggon-way built in 1774 that was ripped up and accompanied by 'rioting'. George Stephenson thought

a railway from the Sheffield Canal basin to Ballifield Colliery, a distance of 5 miles, would not exceed £10,000 but that it may have been better to go the 4 miles to the Handsworth Colliery. That, on 60,000 tons per annum over a distance of 2 miles - taking into account dues, haulage, and return on capital invested, would be 10d per ton in favour of a railway. A.C.M. S246, S.C.L.

(29) A.C.M. S378, S.C.L.

(30) The Manor Colliery

A load of small coal sells at the colliery for	1s	8d
Coal leaders sell for	4s	8d
Coal leaders receive - per load -	3s	0d

Booth's Colliery

Coal leaders lead for - per load -	1s	8d
Booth can sell his coal for more than Lord Surrey at the Manor	1s	4d

The pit worked by Booth and Company was worth £100 per annum or £50 per acre more than the Manor Colliery. A.C.M. S236, S222, S.C.L.

(31) In a reply written to his agent, Norfolk stated that Booth was trying to justify taking out a lease for Fitzwillian coal. A.C.M. 236, S.C.L.

(32) Appendix IV. These figures include sales from the Ponds, Attercliffe, Darnall and Gleadless collieries under direct Norfolk management.

(33) W.W.M. St.P. 4 (vi) A.C.M. S246, S.C.L.

(34) In 1818 total cutlery and hardware exports to the USA amounted to £9.5 million; these by 1820 had declined to £3.9 million, and rose by 1821 to only £6.2 million. Gayer, et al., on. cit., pp 110, 146, 151,232

(35) The collieries referred to are those under direct Rockingham-Fitzwilliam management.

(36) Coal to Attercliffe and Rotherham would have been carried on the Wakefield to Sheffield and Wortley to Rotherham turnpikes.

(37) W.W.M. A1592, S.C.L.

(38) W.W.M. R174, P812, S.C.L.

(38) ... contd ...

Elsecar Colliery Coal Sales 1754:

To coals sold since 2 February 1754	525	pitloads	15	pulls
To coals sent to Kilnhurst	108	"	2	"
To coals for the Marquis to Wentworth	60	"	9	"
To lost coals by ground breaking etc	3	"	6	"
	696	pitloads	32	pulls

1 pit load = 39 pulls
1 pull = 3½ cwt

W.W.M. F96, S.C.L.

Coal purchased from the Lowwood Colliery by the Marquis of Rockingham in 1778:

	£	s	d
Wentworth Woodhouse ...	96	7	6
Gardens	17	18	9
Street Farm	3	2	6
Woodnook Farm	2	7	6
Malt Kiln	8	14	0
Frier House	1	11	10½
Brickyard	8	1	3
Old Moor Farm		17	6
Swinton Stables	8	4	4½
Badsworth	1	17	6
Hooton Limekilns	10	3	9
Lodge	4	14	4½
	£164	10	10½

W.W.M. A16, S.C.L.

(39) W.W.M. R174, S.C.L. One Parkgate waggon = 2 London chaldrons of about 27 cwts each. The Grosvenor Square house coal vaults held 74 chaldrons.

(40) See Appendix XII. W.W.M. F70/92, St. P. 3., S.C.L.

(41) W.W.M. F70/11/16/19, S.C.L. One Parkgate waggon was a little over 85 cubic feet or about 44 cwt.

(42) W.W.M. A244, S.C.L.

Turnpike Subscriptions of the Earl Fitzwilliam, 1815/1816:

Re Rhouse Turnpike	Principal	£ 250
Wheeland "	"	250
Rotherham and Wentworth Turnpike	"	3,700
Sheffield and Wakefield "		600
Rotherham and Wortley "		400
		£5,200

W.W.M. A323, S.C.L.

W.W.M. A331, Earl Fitzwilliam and Viscount Milton held shares to the value of £1,500 in the Sheffield Canal in 1819/20.

(43) W.W.M. F100/6/7, S.C.L.

(44) G.G. Hopkinson, "The Development of Inland Navigation in South Yorkshire and North Derbyshire 1697-1850", Transactions of the Hunter Archaeological Society, Volume 7 (1951-57), 241.

(45) The Dearne and Dove Canal Bill was passed in June 1793, empowering the company to raise £60,000 in £100 shares and if necessary to acquire a further £30,000 on mortgage. By August 1797, the £60,000 had been expended and another Act in 1800 allowed the company to raise a further £30,000 in shares, with permission to borrow £10,000. The canal commenced near the Don Pottery on the Don Navigation in Swinton, and ran for 9.5/8 miles through the main coal-bearing lands around Wath, Wombwell and Ardsley to Barnsley with branches to Worsbrough and Elsecar. It carried boats measuring 58 feet by 14 feet 10 inches, drawing 4 feet 6 inches of water and held between 50 - 60 tons of goods. C. Hadfield, The Canals of Yorkshire and North East England, Volume 2 (Newton Abbot, 1972), pp. 282-285.

(46) W.W.M. F71/14. Letter C. Bowns to Earl Fitzwilliam, 4 December 1796, St. P. 6 (ii), F71/14/15, A295, S.C.L.

(47) Hadfield, op. cit., pp. 284-286. During February 1823, a Mr Allen requested a boat of Swallowwood coal for the Malton

market in North Yorkshire, due to its ' . . . superior quality for malting, being more clear of sulphur than what has been in use with us.' In addition, Allen also thought Elsecar coal was superior for blacksmith use. W.W.M. F107, S.C.L.

(48) W.W.M. A111, S.C.L.

(49) The Cost of Leading Coke from the Haugh Colliery, 1819:

'Coke at Kilnhurst Wharf	9s 6d cash	10s credit
Leading to Brightside	6s 0d per dozen	
" " Park Furnace	7s 0d " "	
" " Attercliffe	6s 6d " "	
" " Sheffield	7s 0d " "	
" " Rotherham	4s 0d " "	
" " Kilnhurst	3s 0d " "	

Price of coke at the pits - 7s 0d per dozen.'

W.W.M. F107/134, S.C.L.

(50) At the Darnall Colliery 'large' coal was 5·5d per cwt; 'small' coal [illegible] per cwt. Mr Swallow's coal at Brightside was 'large' 5·0d per cwt and 'small' 3·0d per cwt. These figures compared with Lowwood Colliery 2.86d per cwt; Elsecar New Colliery 2.92d per cwt, and Elsecar Old Colliery 2.86d per cwt.

W.W.M. F107 S.C.L., Appendix XVI

(51) W.W.M. St. P. 6 (ii), St. P. 5 (i), S.C.L.

(52) W.W.M. St. P. 7(i), St. P. 5 (ii), G40, S.C.L.

(53) G. Mee, Aristocratic Enterprise (Glasgow, 1975), p 29. Fitzwilliam coal under-priced Parkgate, Silkstone, and Flockton, coal at Hull in 1810: Elsecar 20s per chaldron, Parkgate 21s, Silkstone 22s, Flockton 25s. Two chaldrons = 48 cwt. W.W.M. F70, S.C.L.

(54) The lessees of the Elsecar Ironworks included John Darwin, Francis Frith, Joseph Ridge, William Darwin. W.W.M. F70, F71, S.C.L.

(55) Gayer, et al., op. cit., p 74, W.W.M. F106, S.C.L.

(56) The Southwark Bridge was designed by John Rennie and erected at a cost of £8[illegible],0[illegible]. Its weight was 5 - 6,000 tons, being transported from Masborough in sections. The bridge opened in April 1819.

(56) .. contd .. W.W.M. F71, S.C.L. Hunter, op. cit., p 212.

(57)

Year	Coal to the Milton Ironworks	Total Coal Sales of Elsecar Old Colliery	Percentage of Total Sales
1809	4996 doz. 5½ pulls (10492 tons 11½ cwt)	7016 doz 3½ pulls (14734 tons 4½ cwt)	71.21
1810	6615 doz 11 pulls (13893 tons 8½ cwt)	8586 doz 11 pulls (18032 tons 10½ cwt)	77.05
1811	5788 doz 11 pulls (12156 tons 14½ cwt)	8405 doz 2 pulls (17650 tons 17 cwt)	68.88
1812	5302 doz 5½ pulls (11135 tons 3½ cwt)	6233 doz 7 pulls (13090 tons 10½ cwt)	85.05

* * * * * * *

Year	Coal to the Elsecar Ironworks	Total Coal Sales of Elsecar New Colliery	Percentage of Total Sales
1809	12670 doz. (26607 tons)	21813 doz. (45809 tons 4 cwt)	58.08
1810	13503 doz. (28356 tons 6 cwt)	23406 doz. (49153 tons 10 cwt)	57.69
1811	12777 doz. (26831 tons 14 cwt)	23573 doz. (49503 tons 12 cwt)	54.20
1812	5665 doz. 2 pulls (11897 tons 2 cwt)	17848 doz. (37479 tons 18 cwt)	31.74

* * * * * * *

W.W.M. F100/33, S.C.L.

The working of an additional furnace at the Milton Ironworks accounts for the increase in coal sales during 1809/10 from 4996 doz. 5½ pulls to 6615 doz. 11 pulls - a 22.38 per cent rise in the Elsecar Old Colliery coal sales.

(58) W.W.M. St. P. 4 (v), F71, St. P. 5 (iii), S.C.L.

(59) Gayer, et al., op. cit., p 129.

(60) Elsecar Old Colliery sales fell from 11943 dozen (25080 tons 6 cwt) in 1819 to 5394 dozen 10½ pulls (7129 tons 3 cwt) in 1821. See Appendix XV. The Elsecar Old Colliery coal sales advanced to 11767 dozen 8½ pulls (24710 tons 14 cwts) with the Elsecar New Colliery sales rising from 13118 dozen (27547 tons 16 cwts) in 1822 to 15109 dozen (31728 tons 18 cwts) in 1823. W.W.M. F107, S.C.L.

(61) W.W.M. A115, A348, S.C.L. Previously a partner with Graham & Co

at the Milton Ironworks, Henry Hartop was employed at £50 per annum to manage the Elsecar Ironworks. However, the Elsecar Ironworks continued to be worked at a considerable loss. Nee, op. cit. pp.45-6

(62) W.W.M. F107, S.C.L.

(63) W.W.M. F105 (a), 19 June 1818, S.C.L. See Appendix XIII

(64) Appendix XV.

* * * * *

CHAPTER SIX

(1) MD 1387, S C.L.

(2) MD 1387, S.C.L.

(3) The Marquis of Rockingham's Colliery Rental, 1755/56:

	£	s	d
(i) Mr John Bowdon, Carr House Colliery – 12 men at £21 0s 0d per man	252	0	0
(ii) Mr Richard Bingley, Lowwood Colliery – 7 men at £17 17s 0d per man	124	19	0
(iii) Mr William Penny, Orgreave Common Colliery – 1 man at £10 0s 0d per man	10	0	0
(iv) Christopher Fairham – late Benjamin Russele, Westwood Colliery – 2 men at £20 0s 0d per man	40	0	0
(v) Mrs Jackson, Cortwood Colliery – 4 men at £7 15s 0d per man	31	0	0
(vi) Joseph and William Parkin, Bolsterstone Colliery – one year's rent	3	10	0
T O T A L R E N T S D U E	£461	9	0

W.W.M. A228, S.C.L.

(4) NBC 300, S.C.L.

(5) Fitzwilliam Colliery Rentals. 1800:

(i) W. & T. Fenton, Basingthorpe Colliery, 8 acres – £2,080 0 0

(ii) J. Jackson, Greasbrough coal at £120 per acre.

(iii) Longden & Co., Thorncliffe – 1 acre Thick Bed £90 0s 0d
2 acres Thin Bed £140 0s 0d

(iv) Bingley & Co. Wath Colliery, at £40 0s 0d per acre

W.W.M. A291, S.C.L.

Norfolk Colliery Rentals:

	£	s	d
(i) Richard Swallow, Hesley Colliery 1804:			
2 acres Thick Coal	220	0	0
2 acres Thin Coal	80	0	0
2 acres Bromley Coal	80	0	0
(ii) Sorby & Co., Sheffield Collieries, 1805:			
18 acres coal	750	0	0
(iii) Holy & Co., Sheffield Collieries, 1820:			
7 acres Sheffield Bed	2,800	0	0
6 acres Sheffield Manor Bed ...	1,200	0	0
5 acres Handsworth Bed	500	0	0
Any other beds per acre	100	0	0

A.C.M. SD3, SD9(b), SD14, S.C.L.

(6) T.S. Ashton and J. Sykes, The Coal Industry of the Eighteenth Century, (Manchester 1929), pp. 190 – 1.

(7) ibid., p.185, W.W.M. F96, N.B.C. 300, S.C.L.

(8) In 1806, if the Thorncliffe Ironworks worked a seam of over 40 inches with an engine, the rental was £100 per acre, but without a pumping engine it was to be £150 per acre. A.C.M. SD11, S.C.L.

(9) Ashton and Sykes. op. cit., p.188.

(10) D. Hey, "The Ironworks at Chapeltown", Transactions of the Hunter Archaeological Society, Volume 10, part 4 (1977), 225-6. A.C.M. SD2 S.C.L. The landowner sought to protect his long-term agricultural revenue, as coal, whilst returning a high income this was only in the short-term. A clause was sometimes inserted in the lease to protect woods by a penalty of paying double the value of any timber damaged.

(11) A.C.M. S378, S.C.L.

(12) A.C.M. S217, S.C.L.

(13) A.C.M. S205, S232, S.C.L.

(14) A.C.M. SD9(a), S.C.L.

(15) A.C.M. SD14, S.C.L.

(16) J.T. Ward, "Landowners and Mining", in J. T. Ward and R. G. Wilson (eds), Land and Industry: The Landed Estate and the Industrial Revolution (Newton Abbot, 1971), p. 72.

(17) A.J. Taylor, "The Sub-contract System in the British Coal Industry", in L. S.Pressnell (ed), Studies in the Industrial Revolution (1960), pp. 217-218. F. Machin, The Yorkshire Miners, Volume1 (1958) pp. 12-14.

(18) T. W. Beastall, A North Country Estate: The Lumleys and Saundersons as Landowners, 1600-1900 (Chichester, 1975) p.49. A.C.M. S223, S 224, S.C.L. John Buddle, Snr., was viewer in 1792 at the Wallsend Colliery, with his son as assistant - aged 19 years - who was later to become a well-known mine engineer.

(19) A.C.M. S179, S185, S.C.L.

"20 December 1777:

("Received of Mr John Curr the remainder and in
Casual (full for the overvend both of the Wood and
(Manor Pits due Xmas 1775 and 1776 ..... £1,341 1 6 "

Another entry for 2 December 1778 refers to Curr viewing and

examining several collieries for which he was paid £4 5s 2d. Directory of Sheffield 1787, reprinted Sheffield 1889, p. 56, and Directory of Sheffield 1797, p. 61, S.C.L.

(20) A.C.M. S214, S.C.L. John Curr was dismissed on 14 October 1801.

(21) A.C.M. S214, S.C.L.

(22) The Sheffield Park Colliery was in competition with the Attercliffe Colliery as a consequence of the introduction there of Curr's innovations. A.C.M. S225, S224, S.C.L.

(23) O. Wood. "A Cumberland Colliery during the Napoleonic War", Economica, N.S. Volume 21 (1954), 54.

(24) A.C.M. S202, S200, S199, S.C.L.

(25) A.C.M. S214, S.C.L.

(26) A.C.M. S214, S.C.L.

(27) Beastall, op. cit., pp. 36, 57-9, A.C.M. S196, W.W.M. G40 (1), S.C.L.

(28) A.C.M. S199, S198. In 1791 George Curr was paid £40 for labour and assistance at the new engine and in 1793 received £10 10s 0d for one year's attendance at the engines of Sheffield Park Colliery and £63 as agent for the colliery. As agent for the Attercliffe Colliery, Henry Tunchon was paid £54 10s 0d per annum and John Locke received £35 per annum as agent for the Hesley Colliery in 1793.

(29) A.C.M. S231, S226, S185, S.C.L. The colliery agents in 1802 comprised: Attercliffe Colliery - John Jeffcock; Manor Colliery - Martin Elliott; Ponds Colliery - Robert Bower; Hesley Colliery - John Locke, Snr; Handsworth Colliery - John Locke, Jnr.

(30) G. Mee, Aristocratic Enterprise (Glasgow, 1975), p. 80.

(31) W.W.M. St.P. 4 (iii), S.C.L.

(31a) W.W.M. St.P. 5 (ii), St.P. 7 (v), S.C.L.

(32) Benjamin Biram was employed as clerk to his father Joshua, and like Viscount Milton was serving an 'apprenticeship' in colliery and estate management.

(33) W.W.M. P106(a), S.C.L.

(34) W.W.M. G40 (i), S.C.L.

(35) W.W.M. St.P. 6, S.C.L. - Overlookers: Low-wood Colliery - Joseph Hague; Elsecar Old Colliery - Michael Hague; Elsecar New Colliery - John Hague; Westwood Colliery - Michael Hague, Jnr.

(36) W.W.M. F70/93, St.P. 6 (ii), S.C.L.

(37) W.W.M. A54, S.C.L.

(38) Mee, op. cit., pp 90-2

(39) S. Pollard, The Genesis of Modern Management: A Study of the Industrial Revolution in Great Britain (1965), pp. 209-10.

(40) A gin valued at about £15 in 1780 had been in use at the Elsecar Old Colliery for approximately 26 years. W.W.M. F100/2, S.C.L.

(41) John Buddle was comparing John Curr's system of moving corves with the traditional method. A.C.M. S221, S223, S.C.L.

(42) 'Incidental' payments included such items as carpenters and blacksmiths' work, repairs, drawing water for the whimsey and cleaning the boiler.

(43) This was later adopted with the sinking of the New Park Gate and Swallowwood collieries.

(44) Mee, op. cit., p. 197.

(45) Rainber Park Colliery - 'Capital Expended' -

1822	£4,074	15s	9d
1825	£4,200	0s	0d
1826	£4,450	0s	0d
1827	£5,300	0s	0d

W.W.M. A105, A113, A115, S.C.L.

* * * * *

CONCLUSION:

(1) G.E. Mingay, English Landed Society in the Eighteenth Century (1963), p. 197.

(2) ibid., p. 167

(3) ibid., p. 201. F.M.L. Thompson, English Landed Society in the Nineteenth Century (1963), p. 264.

(4) G.E. Mingay, op. cit., p. 190.

* * * * *

GLOSSARY OF MINING TERMS

* * * *

Anthracite: Hard, shiny black coal containing the lowest proportion of water and volatile matter and highest fixed carbon content. Burns at high temperatures with a smokeless flame. A very high quality coal.

Banks: Places where the coal has been extracted that run at right angles to the level.

Banksman: Checks the coal as it reaches the surface and marks the corf down to the appropriate collier for the calculation of wages. In smaller collieries the banksman supervised the surface work, land-sale coal, and kept the accounts.

Barrow-man or barrower: Hauled the coal from the workings to the shaft bottom either in a barrow or sledge. Following the introduction of horse-drawn corves, they were generally referred to as hurriers or trammers.

Bassett: Coal that lies near the surface.

Bind: Laminated mud-stone in irregular blocks, but commonly referred by miners to any fine-grained rock.

Black Band: An ironstone that contains sufficient carbonaceous matter to enable it to be calcined without any additional fuel.

Black Shale: A shale often found as a roof to the coal.

Blacks: A black shale, sometimes a stone coal, especially in the roof of a coal seam.

Blaes and Bails: A blue bind with ironstone nodules.

Blue Bind: Bluish-grey or bluish-black rock commonly applied to any fine-grained shale or mudstone.

Blue Stone: A West Yorkshire term, generally a sandstone.

Boardgate or Barrow-gate: Roadways from the deep level to the shaft and forward to the coal face.

Branch: A dull coal, the best part of the Silkstone seam.

Brass or Basses: Iron pyrites.

Dye Pit: A shaft up which the coal is hauled and workers lowered and raised.

Cannel Coal: Formed under water.

Clod: Mudstone, shale or clay often found as a roof to the coal or as partings in the seam.

Dandies: Mainly an inferior coal, usually consisting of dirty brights.

Dirt or Dirt Parting: Any soft, shaly material interbedded with the coal.

Dyke, Nare, Fault: Where the rock strata has slipped, throwing the coal downwards.

Endways: A watercourse that runs at right-angles to the counter-levels towards the bassett of the colliery.

Engine Pit: A shaft above which is placed a pumping engine to raise water from the colliery.

Fillers: Load or fill the corves with coal after the hewer has brought it down from the face.

Fireclay: A type of clay.

Fire Engine: Common name for an atmospheric or steam pumping engine.

Fire Pan: A receptacle for burning coal positioned at the bottom of a shaft to generate a movement of air for ventilation.

Ganister: A quartzite, often found beneath a seam of coal used for furnace linings.

Grey Bind: A mudstone or shale with much sand or silt.

Headings: Openings made into the coal from which the coal is worked.

Hewer, Collier, Getter, Pickmen: Skilled workers who bring the coal down from the face.

Kibbles, Corves: Wicker-work baskets usually made from hazel branches and used to hold the coal. Sometimes referred to as corves, but these are usually the solid wood and iron-sided receptacles later fitted with four wheels.

Levels: A watercourse to the deep of the colliery to drain the coal towards the bassett. A counter-level runs parallel to the deep level from which it is separated by a rib of coal, and is so designed to catch or sieve the silt to prevent blocking the deep level.

Mudstone: A fine-grained clay.

Overlooker or Overseer: A person that supervises the working of a colliery.

Plateway: A railway or waggon-way made of wood plated with cast-iron to reduce wear.

Post: A rib of coal left to support the roadways or roof between the banks. Post holes are cut to improve communication to the shaft and assist ventilation.

Punches: Pit props.

Seat Earth: Dirt located at the bottom of the coal seam.

Shale: Locally called binds, containing a mixture of sand, and similar to sandstone. Beds of this are known among colliers as 'stone binds' or 'rock binds'.

South: A tunnel driven at a slight upward gradient from a valley side to the deep of a colliery for drainage.

Stacker: Takes the coal from the pit top to be stacked ready for sale.

Swilley: Local areas where the coal thickens.

Tipler: A device which tips the corf on reaching the pit top, to enable the coal to be loaded into waggons.

Tram: To enable the coal to be hauled from the coal-face to the shaft. The kibbles or corves were placed on trams or sledges and dragged along the roadways. The tram was later fitted with wheels.

Underground Agent: In larger collieries, they supervised the work underground. The pit top was controlled by surface agents.

Washout: Where the coal is replaced by a downward movement of the roof-measures, and probably originated by the transport and deposition of sediments where a stream crossed the coal strata.

Wayleaves: A right-of-way granted above or below ground by a landowner to transport coal across his property; usually in payment of a sum of money.

Whin-gin or Whimsey: Horse-driven winding-gear for raising coal to the surface.

* * * * *

A P P E N D I C E S

APPENDIX 1

Principal seams of coal and ironstone in geological order and average thickness:

		ft.	in.
1.	Weth Wood or Huck Seam	4	6
2.	Woodmoor Seam	3	0
3.	Winter Seam	5	4
4.	Upper Beamshaw Seam	4	8
5.	Lower Beamshaw Seam	2	2
6.	Kent's Thin Seam	2	7
7.	Kent's Thick or High Hazel Seam	5	0
8.	Barnsley Thick Seam	9	0
9.	Swallow Wood Seam	5	0
10.	Tankersley Ironstone		
11.	Howard or Flockton Seam	5	0
12.	Black Mine Ironstone		
13.	Fenton's Thin Seam	2	3
14.	Parkgate or Chapeltown Seam	6	9
15.	Yellow Mine Ironstone		
16.	White Mine Ironstone		
17.	Thorncliffe Thin Seam	2	6
18.	Four Foot Seam	4	0
19.	Claywood Ironstone		
20.	Silkstone or Sheffield Seam	5	0
21.	Whinmoor, Charlton Brook, or Mortomley Seam	3	0

Note: Black Mine Ironstone found with Fenton Seam.

A.H. Green and R. Russell, Geology of Yorkshire Coalfield, (1878), pp. 79-80

P. Jeffcock, "On the Coal and Iron Mining of South Yorkshire",

The Institute of Mechanical Engineers, (1862), 68 - 9.

APPENDIX II

Composition of the Barnsley Hard Coal:

	Specific Gravity	Carbon	Hydrogen	Nitrogen	Oxygen	Sulphur	Ash	Percentage of coal yielded
Lord Fitzwilliam, Elsecar	1.296	81.93	4.85	1.27	8.58	.91	2.46	61.6
Lord Fitzwilliam, Parkgate	1.311	80.07	4.92	2.15	9.95	1.11	1.80	61.7
Hoyland and Elsecar Colliery	1.317	80.05	4.93	1.24	8.99	1.06	3.73	62.5

Barnsley Coal at Tinsley Park Colliery - by Mr H Chambers:

	Ft.	Ins.
Tops, inferior house coal	1	0
Bright or house coal	0	8
Hard furnace coal	0	6
Dad coal	0	2
Furnace coal	1	0
Soft coal	1	0
	4	4

Barnsley Coal, Lord Fitzwilliam's Elsecar Collieries - by Mr Thos Cooper:

	Ft.	Ins.
Daggs	1	6
Top Softs	1	6
Hards	4	6
Bottom Softs	1	6
	9	0

APPENDIX II (Contd)

Composition of the Silkstone Seam:

Woodthorpe Colliery, Sheffield, where the seam appears at its best - by Mr Higginbotham, steward:

		Ft.	Ins.
Top Bed	(Branch coal	1	2
	(Coal	1	4
Dirt			7
Low Bed		3	7

Silkstone Seam at Chapeltown - by Mr H Cooke:

	Coal		Parting		Coal	
	Ft.	Ins.	Ft.	Ins.	Ft.	Ins.
Pit in middle of Smithy Wood	2	2	30	0	2	0
Pit in Hesley Park	2	0	18	0	2	0

The Claywood Ironstone at Hesley Park Wood - by Mr H Cooke:

			Ft.	Ins.
Claywood Mine	1.	Ironstone measure, white, in two beds	0	4
	2.	Strong white bind	6	0
	3.	Ironstone bed, white	0	4
	4.	White earth and black shale	3	0
	5.	Ironstone bed, black	0	4
	6.	Black shale, with large balls of black ironstone	0	6½
		Measures	18	0
		Silkstone Coal		

A.H. Green and R. Russell, Geology of the Yorkshire Coalfield (1878), pp. 230, 232, 250, 302, 306.

APPENDIX III

The Estimated Expense of Opening a Colliery at Crooks Croft, Sheffield:

The colliery to work 315 acres of coal at an average of seven acres per annum, to last for 45 years, working at a depth of 52 yards.

"The Fire Engine (or engines) with all materials and fitting up, both in the House and pit, with the sinking charge and keeping of the engine, during the time of sinking; also of fitting up the sets at the completion of the sinkings and everything else necessary	£5,000
Sinking a Bye Pit, for drawing the coals; fitting up the conductors in the shafts; opening out proper standage for the water; extending 500yards of navigation underground; opening out and securing the Barrowgaits; building boats and cranes; fitting up a water wheel to draw the coals; making a receiver for the water employed to drive the wheel; making a communication between the receiver and the wheel; covering in the machinery, and doing everything to put the colliery in a fair working condition	£2,690
Completing the coal-yard	£ 500
	£8,190 "

Estimated Cost of Opening a Colliery in Mr Matthewman's Croft near the Ponds:

"The colliery to drain and work 189 acres at 7 acres per annum on average for 27 years. Depth of engine shaft to be 30 yards to lift the water 25 yards.	
Fire Engine and all materials and completing the winning	£2,000
Sinking a Bye Pit for draining coals; fitting up conductors; opening out proper standage; extending 500 yards navigation underground; opening Barrowgaits, drifts and air courses; building boats, wheel corves and canes; erecting machine drawing coals; covering in shaft and machinery from weather; making reservoir for driving the wheel and a communication for the water, etc. etc. to set colliery in working state	£1,800
Making coal-yard, and defraying expense of purchase to clear the ground, pulling down houses etc. etc.	£ 700
	£4,500 "

A.C.L. S223, S.C.L. A Report on the Sheffield Park and Attercliffe Collieries by John Buddle, 1787.

APPENDIX IV

"An Account of the quantity of coals consumed in Sheffield and its manufactories in one year as given in by the managers at the different collieries under-mentioned:

From SHEFFIELD POND pits - reckoning the men to work			5 days in each week -	150	tons per day
" ATTERCLIFFE			-do-	150	-do-
DARNALL			-do-	80	-do-
BIRLEY - reckoning teams to go 5 days weekly				4	-do-
GLEADLESS	-do-		-do-	10	-do-
HOSBRO	-do-		-do-	5	-do-
WOODHOUSE	-do-		-do-	2	-do-
BRAMLEY MOOR	-do-		-do-	6	-do-
TROWAN	-do-		-do-	10	-do-
WESTWOOD	-do-		-do-	5	-do-
HESLEY	-do-		-do-	4	-do-
BROMLEY	-do-		-do-	5	-do-
WORTLEY	-do-		-do-	3	-do-
COLE ASTON	-do-		-do-	5	-do-
				439	
				5	x
				2,195	
HIGH HAZLE)				52	x
) Quantity not				4,390	
INTAKE PARK) ascertained.				109,750	+
				114,140	

Total Quantity probably not less than 125 tons per annum "

HD 1746-5, S.C.L. Deeds and papers of William Dunn of Sheffield, engineer, and his son, Thomas.

APPENDIX V

The Major Capital Stock of the Sheffield, Manor, and Handsworth Collieries in 1805:

1. 5 pumping engines: one 40-inch, two 50-inch, and one 60-inch diameter cylinders.
2. 5 whimseys for drawing coal.
3. 5 steam winding engines.
4. 5 weighing machines
5. 4 pits with conductors.
6. 3,365 yards of railway above ground (cast-iron metal railway and plateway at 4s per yard).
7. 11,001 yards of railway underground (cast-iron railway at 4s per yard)
8. 123 corves at 25s each.
9. 109 tub corves at 32s each.
10. 121 corves at 36s each.
11. 20 tub corves at 16s each.
12. 4 corves 'compleat' - total value 1s 6d.
13. 131 basket corves - total value £52 8s 0d.
14. 118 trams with metal wheels - total value £64 18s 0d.
15. 2 old kibbles - total value 3s 6d.
16. 8 old tub corves - total value £2 8s 0d.
17. 50 coke ovens (41 at the Ponds, 9 at the Manor).
18. 6 coke ovens for 'burning soft cynders'.
19. One coal screen
20. 32 horses (6 Darnall; 6 Rail Road; 5 Pit; 6 Park; 9 Ponds Stables).
21. 4 asses (3 Pit; 1 Park).

The Farms:

		Acres	Roods	Perches
High Hazle Farm:	Land in good condition	52	11	0
	Land in poor condition	7	2	0
Sheffield Park Farm:	In good condition	61	12	0

Individual Colliery Valuations:

	£	s	d
Handsworth Colliery	6,381	6	8
Sheffield Colliery (includes Crooks Croft Pit @ £3219-0-2)	5,942	1	4
Manor Colliery	332	17	9
Colliery Livestock	443	8	0
Fodder and Equipment	620	4	6⅔
Property belonging to the Collieries	2,795	9	0
	£16,515	7	3⅓

(A C.M. 8205, S.C.L.)

Capital Stock left at the Hesley Colliery 23 November 1805: £733 4s 3½d, included:

1. A machine for drawing coal - £250.
2. Conductors.
3. 42 corves at 10s each.
4. 481 yards railroad.

(M.D. 1746-10, S.C.L.)

APPENDIX V (Contd)

The Major Capital Equipment at the Sheffield Collieries in 1820:

1. 1 Pumping engine - 61-inch diameter cylinder.
2. 2 whimseys for drawing coal.
3. 4 steam winding engines.
4. 2 corf weighing-machines.
5. 3 pits with conductors.
6. 3,444 yards of railroads above ground.
7. 10,244 yards of railroad underground.
8. 232 corves at 33s 4d each.
9. 238 corves at 30s 7d each.
10. 40 corves at 55s each.
11. 13 iron corves at 61s each.
12. 4 bind corves.
13. 42 coke ovens at £8 each.
14. 1 large coke oven £18.
15. Ovens for soft cokes £17.

Individual Colliery Valuations:

	£	s	d
Darnall Colliery	3,614	7	10
Sheffield Colliery	3,219	8	11
Woodthorpe Colliery	724	8	6½
88 corves	233	4	0
	7,791	9	3½
Deduct articles taken away by Sorby & Co after valuation from the Darnall Colliery	42	10	10 -
	£7,748	16	4½
Valuation of the buildings	£1,548	10	0

(The valuation of the buildings includes £20 of property sold, £165 claimed from the lessees, £148 demolished and an engine house on a long lease to Mr Sorby but partly pulled down - valued at £400).

(A.C.M. S232, S.C.L.)

Working Pits in 1805:

1. The Main Fire Engine, Attercliffe Common
2. Thin Coal Pit, Attercliffe Common
3. Darnall Pit
4. Coal Yard Pit
5. Stubbing Hill Pit, High Hazle
6. Main Fire Engine, High Hazle
7. Ox Close Pit, High Hazle
8. Break Back Pit, High Hazle
9. Pit in Mr Staniforth's land
10. Crooks Croft Main Engine Pit
11. Pit for drawing coal at Crooks Croft
12. Ponds Fire Engine Pit
13. Schoolfield Machine Pit
14. Manor Colliery 1st Level Pit No.12
15. Manor Colliery 2nd Level Pit No.13
16. Manor Pit

(A.C.M. S205, S.C.L.)

Working Pits in 1920:

1. Greenland Engine Pit, Atter/fe.
2. Darnall Pit
3. Flat Pasture Pit
4. Deep Pit No. 1
5. Deep Pit No. 2
6. Woodthorpe Pit

(A.C.M. S232, S.C.L.)

APPENDIX VI

"An Account of the Quantity of Parkgate Coals sent down the River Dun from the 30 September 1771 to the 29 September 1774, being three years."

Messrs Fentons	Coals		Messrs Hirst & Co	Coals Waggons	
1771 Sept. 30 to) Dec. 31)	5,855		1771 Sept. 30 to) Dec. 31)	4,206	
1772			1772		
To March 25	4,118		To March 25	2,748	
To June 24	5,594		To June 24	3,394	
To Sept. 29	4,922	20,489	To Sept. 29	3,819	14,167
To Dec. 31	6,512		To Dec. 31	4,339	
1773			1773		
To March 25	4,551		To March 25	3,406	
To June 24	4,056		To June 24	2,978	
To Sept. 29	4,778	19,897	To Sept. 29	3,785	14,508
To Dec. 31	6,566		To Dec. 31	4,283	
1774			1774		
To March 25	3,833		To March 25	3,150	
To June 24	5,667		To June 24	4,574	
To Sept. 29	4,993	21,059	To Sept. 29	3,688	15,695
	Total	61,445		Total	44,370

W.W.M. F70/25-1, S.C.L.

"An Account of the Quantity of Coals sent down the River Dun from Rotherham, from the 29 September 1774 to the 29 September 1780 being six years."

Messrs. Fentons			Waggons	Messrs. Hirst & Co			Waggons
Sep.29 1774 to) " 1775)	Coals	18,415		Sep.29 1774 to) " 1775)	Coals	13,069	
	Slack	105	18,520		Slack	1,264	14,333
to Sep.29 1776	Coals	15,125		to Sep.29 1776)	Coals	11,306	
	Slack	230	15,355		Slack	970	12,276
to Sep.29 1777	Coals	19,190		to Sep.29 1777	Coals	12,260	
	Slack	322	19,512		Slack	1,037	13,297
to Sep.29 1778	Coals	17,096		to Sep.29 1778	Coals	10,928	
	Slack	312	17,408		Slack	1,023	11,951
to Sep.29 1779	Coals	17,352		to Sep.29 1779	Coals	10,854	
	Slack	380	17,732		Slack	939	11,793
to Sep.29 1780	Coals	16,027		to Sep.29 1780	Coals	9,989	
	Slack	394	16,421		Slack	515	10,504
			104,948				74,154

W.W.M. F70/19, S.C.L.

APPENDIX VII

The Major Suppliers of Metal Goods to the Fitzwilliam Collieries

Date	Darwin & Co £ s d	Henry Hartop £ s d	Newton & Co Thorncliffe Ironworks £ s d	Joshua Walker & Company £ s d	Booth & Company £ s d	Liversedge & Crowshaw £ s d	Total £ s d
1795	581 13 7		325 6 10				907 0 5
1796	158 17 5½		179 13 4				338 10 9½
1797	189 18 4½			29 15 2			219 13 6½
1798	274 2 4½		278 4 7	109 18 11	12 17 11		675 3 9½
1799	424 10 2½		156 6 0½	179 17 1			760 13 4
1800	403 4 11½		267 15 10	258 9 11			929 10 8½
1801	263 9 2½		304 16 8½	209 16 11	Walkers & Booth	189 9 0	967 1 10
1802	358 9 11		157 19 7	160 15 9	11 15 3		657 5 3
1803	531 4 5½		391 16 8½	144 6 10			1079 3 3
1804	314 6 10		353 17 4½	215 2 5	18 0 6		901 7 1½
1805	434 6 7		353 3 11	115 7 11	4 5 0		907 3 5
1806	305 7 7½		202 9 7	124 0 10			631 18 0½
1807	174 6 4		216 14 9½	117 7 1	16 9 1		524 17 3½
1808	379 14 1½		174 10 1½	242 13 8	14 16 0		841 13 10½
1809	465 11 0½		261 8 7	164 2 10	13 4 4		904 6 9½
1810	594 8 7		242 9 9½	121 7 6	35 6 0		993 11 10½
1811	279 18 3½		247 16 4	109 4 8	11 16 0		648 15 3½
1812	290 14 7½		166 14 1	103 18 1	17 17 11		579 4 8½
1813	228 16 6		423 10 5	74 4 9	13 1 9		739 13 5
1814	240 5 10		222 15 9½	62 0 4	6 18 10		532 0 9½
1815	241 2 9½		225 13 4½	187 14 3	18 5 6		670 15 11
1816	232 1 1½		317 5 9	49 17 11			599 4 9½
1817			388 6 11½	56 18 1	21 2 3		466 7 3½
1818			233 10 8½	88 6 0	8 7 4		330 4 0½
1819			584 2 2½	223 4 10	3 0 1		810 7 1½
1820	1076 13 3½		618 3 0½	115 0 9	14 12 11		1824 9 11½
1821	69 19 8		592 13 2	120 3 5	6 16 3		789 12 6
1822		833 2 9	552 0 10½	168 1 4	326 9 11		1879 14 10½
1823		953 17 2	898 4 9½	589 11 4	52 0 0		2493 13 5½
1824			1481 19 0½	56 2 8	9 10 7	64 15 1	1612 7 4½
1825	841 5 11½	2267 1 8	1351 1 8		7 6 4	215 0 4	4681 15 11½
					Oxley & Hodgson		
1826			1499 13 0½	Graham &	118 10 5		1618 3 5½
1827	866 4 6	569 10 10½	1294 14 6½	Company	115 1 11	130 5 2	2975 17 0
1828		907 15 11½	54 17 3½	Milton	104 11 4	106 18 5	1174 2 11½
1829		1020 13 2		Ironwks		30 1 6	1050 14 8
1830		768 2 11		100 17 2			895 13 1

Notes to Appendix VII

1. Unless stated, place of manufacture is unknown but the bulk of the goods would have been produced at the Elsecar, Milton and Thorncliffe Ironworks.

2. Local Manufacturers:

Darwin & Company:	Elsecar Ironworks until 1827; Chapel Ironworks until 1827.
Walker & Company:	Milton Ironworks until 1821; Masborough Ironworks.
Henry Hartop & Co:	Milton Ironworks 1821; took on new partners William and Robert Graham 1824, until dissolved 1827, Grahams became sole lessees until 1848.
Earl Fitzwilliam:	Elsecar Ironworks taken into direct management 1827, with Hartop as manager.

APPENDIX VIII

Fitzwilliam Collieries Expenditure on Metal Goods

Date	Elsecar New Colliery			Lowwood Colliery			Elsecar Old Colliery			Hainber Park Colliery			New Parkgate Colliery			Swallow-wood Colliery			Total		
	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d
1795	907	0	5																907	0	5
1796	496	19	4½																496	19	4½
1797	217	9	0½																217	9	0½
1798	470	0	8½	542	6	1½													1012	6	9½
1799	394	0	1½	366	13	3													760	13	4½
1800	833	6	7½	96	4	1													929	10	8½
1801	840	8	10	59	10	7½	67	12	4½										967	11	10
1802	400	7	4½	263	8	0½													663	15	5
1803	751	14	3	327	9	0													1079	3	3
1804	684	9	10½	216	17	3													901	7	1½
1805	535	17	3½	388	6	9½													924	4	1
1806	462	15	6½	213	10	6													676	4	0½
1807	356	15	11½	168	1	4													524	17	3½
1808	611	11	6	200	3	2½													811	14	8½
1809	601	15	6½	865	8	6	15	15	0										1482	19	2½
1810	557	9	2	417	8	6	18	14	2½										993	11	10½
1811	392	8	1½	245	10	8½	82	16	5½										720	15	3½
1812	609	19	9½	140	10	6	20	17	5										771	7	8½
1813	484	5	10½	282	4	4½	81	19	7½										848	9	11
1814	360	2	4	130	13	1½	41	5	6½										552	0	11½
1815	438	9	9½	252	7	6½	101	14	6										792	11	10
1816	241	19	10½	326	11	9	54	15	2										623	4	9½
1817	283	18	2	182	9	1½													466	7	3½
1818	231	15	3½	87	5	10	26	17	3										345	18	4½
1819	380	6	7	50	6	2	174	12	6½	225	1	10							810	7	1½
1820	334	18	2½	132	2	2	99	10	8½	1315	19	9½							1894	5	7½*
1821	205	10	3½	51	19	7	58	1	1	219	4	7½	279	16	3				814	11	10
1822	365	9	3	117	9	2				7	10	11	2231	15	6½				2726	3	0½*
1823	556	11	5½	101	15	10½	211	8	4½	35	11	10½	1698	3	0½	2	3	0	2805	13	8
1824	61	17	6	240	5	7	147	2	4½	83	11	5	1077	14	11½	113	15	6	1724	7	1
1825	550	9	4½	78	7	6½	962	10	7	136	3	2	859	19	8½	698	9	5½	3285	19	10½
1826	523	11	6½	39	5	5	231	17	2½	146	13	8½	838	1	8½	31	9	5½	1810	19	0½
1827	523	19	11½	184	15	4	242	12	4	99	0	1½	3007	14	11½	316	11	2½	4374	14	0
1828	602	18	11	110	2	5	136	9	8½	15	8	0	797	18	4½	6	10	7	1669	7	11½
1829	341	5	8	4	10	1	57	9	6				453	14	0	193	15	5	1050	14	8
1830	427	3	8				97	2	1				300	1	8	71	5	8	895	13	1

* Hawsh Colliery:

1820 ..... £11 14s 9d

1822 ..... £ 3 18s 2d

APPENDIX IX

The Division of Labour in the Sheffield and Handsworth Collieries 1820

The Sheffield Colliery

Number Employed	Work specification	
1	Steward	
2	Clerks	
1	Horsekeeper	
2	Coke Burners	
2	Blacksmiths	
2	Carpenters	
6	The Farm	
5	Banksmen - No. 1 Deep Pit	
5	Banksmen - No. 2 Deep Pit	Total
99	Colliers, etc. in the Deep Pits	Employed: 125

The Handsworth Colliery

Number Employed	Work specification	
1	Steward	
4	Engine Men	
2	Whimsey Men	
3	Carpenters	
2	Sawyers	
4	Blacksmiths	
9	Yardsmen	
2	Topsmen	
2	Corf Greasers	
1	Weigher at the Pit	
4	Labourers	
1	Horse Tenter	
1	Wood Cutter	
1	Jinney Man	
86	Colliers	
4	Labourers in the Pit	
15	Lads in the Pit	
5	Trappers	Total
15	Lads on the Corf Road	Employed: 162

M.D. 3629, S.C.L.

APPENDIX IX (Contd) (i)

The Division of Labour in the Fitzwilliam Collieries

Elsecar New Colliery, 1808

Number Employed	Work Specification	
31	Colliers	
22	Trammers	
8	Ginneymen	
1	Packer	
1	Road Mender	
2	Hanger	
1	Horse Tenter	
10	Horse Lads	
5	Topsmen	
2	Whimsey Tenters	
2	Corf Greasers	
1	Corf Mender	
3	Labourers	
1	Cinder Burner	
2	Blacksmiths	
1	Engine Tenter	
1	Carpenter	Total
1	Collier but past work	Employed: 95

Elsecar Old Colliery, 1808

9	Colliers	
3	Topsmen	
1	Filler	
3	Horse Lad	
2	Gin Drivers	
1	Hanger Off	Total
1	Horse Tenter	Employed: 20

(Stw.P.13, S.C.L.)

Lowwood Colliery, 1812

8	Getters	
10	Getters and Trammers	
6	Trammers	
2	Ginney Tenters	
2	Horse Lads	
1	Hanger On	
1	Banksman	
2	Whimsey Tenters	
2	Stackers	
1	Corf Greaser	
2	Labourers	
1	Blacksmith	Total
1	Carpenter	Employed: 39

APPENDIX IX (Contd) (ii)

The Division of Labour in the Fitzwilliam Collieries (Contd)

Cortworth, 1812

Number Employed	Work Specification	
4	Getters and Trammers	
1	Whimsey Tenter	
2	Banksmen	
1	Stacker	Total
1	Underground Man	Employed: 9

(F 105/c, S.C.L.)

Elsecar Old Colliery, 1813

11	Colliers	
7	Trammers	
2	Topsmen	
2	Horse Lads	
2	Gin Drivers	
3	Drifters	Total
1	Horse Tenter	Employed: 28

(Stw. P.13, S.C.L.)

Elsecar New Colliery, 1813

21	Colliers	
16	Trammers	
10	Labourers	
15	Ginneymen	
8	Topsmen	
2	Whimsey Tender	
4	Horse Lads	
1	Horse Tender	
1	Cinder Burner	
3	Blacksmiths	
2	Carpenters	Total
1	Engine Tender	Employed: 84

(Stw. P.13, S.C.L.)

APPENDIX X

Weights and Measures at the Norfolk Collieries

1. A 16 peck (4 bushel) corf = 140 lb of coal or 2 long hundredweights.
2. A waggon = 40 long hundredweights or 42½ cwt. avoirdupois.
3. A cart load = 16 long hundredweights or 17⅔ cwt. avoirdupois.
4. A "ten" = 44 (cart) loads or 38 tons avoirdupois.
5. Sheffield Park Colliery 1781-1801 and Attercliffe Colliery 1788-1801:
   1 corf = 6 cwt.
   5 corves = 1 waggon = 30 cwt.

Weights and Measures at the Rockingham-Fitzwilliam Collieries 1750-1830

1. 1760 Lowwood dozen = 42 cwt.
2. 1760 Elsecar Colliery: 39 pulls = 1 pit load = 140 cwt: therefore 1 corf = 3.5 cwt.
3. 1793 Lowwood Colliery: 39 corves = 1 pit load: the corves are one-third larger than those at Elsecar.
4. 1793 Elsecar Colliery: 1 pit load = 3½ dozen.
5. 1797 Lowwood Colliery: 1 pit load = 3½ dozen = 26 corves.
6. 1797 Elsecar New Colliery: 1 pit load = 25 corves.
7. 1797 Elsecar Old Colliery: 1 pit load = 40 corves.
8. 1800 Lowwood Colliery: 6 corves/pulls = 1 dozen. Each corf = 7 cwt. 42 cwt. = 1 dozen: 48 cwt. = 1 waggon.
9. 1800 Elsecar New Colliery: 7 corves/pulls = 1 dozen. Each corf = 6 cwt. 8 corves = 1 waggon; 1 waggon = 48 cwt.
10. 1800 Elsecar Old Colliery: 12 corves/pulls = 1 dozen. Each corf = 3½ cwt: 42 cwt. = 1 dozen: 48 cwt. = 1 waggon.
11. 1790-1800 Westwood Colliery: 24 pulls = 1 dozen, if there are 42 cwt. per dozen: therefore 1 pull = 1¾ cwt.
12. Rainber/Brampton Colliery: 14 pulls = 1 dozen; 1 pull = 3 cwt; 19 corves = 1 waggon; 42 cwt. = 1 dozen; 57 cwt. = 1 waggon.
13. Swallow Wood Colliery: 1 waggon = 3 tons; 1 corf = 3 cwt; 20 corves = 1 waggon coal; 12 corves = 1 waggon slack: therefore 5 cwt = 1 corf.
14. New Parkgate Colliery: 12 corves = 1 waggon slack; therefore 1 corf = 5 cwt.
    10 corves = 1 waggon coal, therefore 1 corf = 6 cwt. and 1 waggon = 3 tons.

* * * * *

APPENDIX XI

The Proportion of Coal Worked in the Fitzwilliam Collieries

Lowwood Colliery

Date	Total Coal Broken Into: Acres	Coal Supposed Clean Got - Acres	Percentage coal Clean got.
April 1798-July 8 1802	7.21527	4.45174	61.69886
July 8 1802-Oct 12 1803	3.50349	2.32737	66.43004
Oct 12 1803-June 22 1804	2.19813	1.40961	64.12769
June 22 1804-July 20 1805	3.08585	2.39474	77.6039
July 20 1805-July 21 1806	4.92777	3.65303	74.1315
July 21 1806-July 3 1807	2.09323	1.64973	78.81264
July 3 1807-July 5 1808	1.99347	1.44789	72.63164
Elsecar New Colliery			
Sept 26 1795-July 15 1802	23.65741	15.66274	66.20648
July 15 1802-Oct 7 1803	6.22970	4.53226	72.755245
Oct 7 1803-June 21 1804	3.89765	2.63465	67.59585
June 21 1804-July 24 1805	8.17978	4.02656	49.22577
July 24 1805-July 10 1806	4.91560	3.60778	73.39449
July 10 1806-July 9 1807	4.95357	3.70621	74.81896
July 9 1807-July 5 1808	5.53713	4.17579	75.41433
Elsecar Old Colliery			
July 16 1802-Sept 30 1803	1.62779	1.39361	85.61362
Sept 30 1803-June 13 1804	1.17574	1.01444	86.28098
June 13 1804-July 25 1805	2.00117	1.64677	82.29036
July 25 1805-July 9 1806	1.77279	1.50460	84.87186
July 9 1806-July 10 1807	1.20828	1.46372	121.14079
July 10 1807-July 5 1808	1.72644	1.46874	85.07333

In addition, part of the coal between the counter heading and the bottom of the banks may later be worked along with the greater part of the boardgate posts, slant-heading posts and stable posts. The coal between the level and counter level and post between the banks were to remain. Thus approximately 20 - 25 per cent of the remaining coal would be mined.

W.W.M. F100/14, S.C.L.

APPENDIX XII

"My Lord

I must humbly beg leave to lay before your Lordship a statement of what coal may be delivered for in London from Elsecar Colliery:-

	£	s	d
"Suppose 30 cwts at the pit to make a London chaldron of 25 cwt worth at pit		4	6
Freight to Thorn per chaldron		2	6
Dues of Dearne and Dove, and River Dun		2	0
Freight to London from Thorn		8	0
Bill entry and fee at Custom House Cockett fee, water bailiff, etc. Trinity Dues Hove Light Lord Mayor's Dues King's Duty, Bond and Meters Sacks		12	2
Metage and Orphan Duty Labourers Discount, Scarcage and Expences Commission			
	£1	9	2

W.W.M. F70/92, S.C.L: D. Hall, 6 November 1797: 'Copied from an account of Mr Deakin's.'

APPENDIX XIII

The Price of Coal at the Fitzwillian and other local collieries: 19 June, 1818

"Lowwood Colliery: 10s per dozen: weight 42 cwt.

Elsecar New Colliery: 13s 1½d per waggon: weight 54 cwt.

Elsecar Old Colliery: 10s per dozen: 8s 6d per dozen to Messrs. Walkers and the bags 7s 6d per dozen: weight 42 cwt.

Mr Kent's Colliery: 8s per dozen: weight 42 cwt.

James Beevor's Colliery: 8s 6d per dozen: weight about 44 cwt. and the price to the canal considerably less as they give additional measure.

Worsbrough Colliery: 12s per waggon of about 60 cwt - more to some: 8s per waggon for lime coal: some boats coal paid according to the 'bargain'.

Barnsley Collieries: 12s per dozen: weight not known but boatmen say they have as many coals for 14 waggons as at Elsecar for 15 - some say 16 - waggons.

Gawber Colliery: 11s per waggon: probably weigh 60 cwt.

Silkstone Collieries: 17s per waggon from 66 to 68 cwt: allow 6d to 1s per waggon discount for 'ready money'.

Mr Fenton's Colliery: 15s per waggon: some say 2 - 3 waggons per boat-load if carry 20 waggons, or more, and less in proportion.

Most of the collieries allow 6d probably 1s per waggon discount for 'ready money'. "

W.W.M. P105(a). S.C.L.

APPENDIX XIV

The Coal Output of the Fitzwilliam Collieries (tons)

Year	Elsecar New Colliery	Lowwood Colliery	Elsecar Old Colliery	Rainber Park Colliery	New Parkgate Colliery	Swallow-wood Colliery	Total Output
1754/55			4,200				4,200
1768		11,342	2,127				13,469
1769		8,845	3,534				12,379
1770			2,016				2,016
1771			2,837				2,837
1780			3,001				3,001
1781		17,170	2,268				19,438
1789		20,324	3,360				23,684
1798	12,710	27,799	5,631				52,715*
1799	19,568	29,031	7,581				61,835*
1800	45,823	13,561	7,105				66,810*
1801	36,135	7,531	12,138				55,804
1802	33,355	18,110	18,368				69,833
1803	34,745	18,168	17,468				70,381
1804	38,647	19,895	18,371				76,913
1805	40,113	27,083	16,040				83,236
1806	37,436	25,601	13,828				76,865
1807	37,374	13,705	13,174				64,253
1808	41,303	22,639	14,661				78,603
1809	45,099	19,414	15,585				80,098
1810	49,249	23,260	18,273				90,782
1811	49,677	26,394	17,962				94,033
1812	43,449	22,915	15,848				82,212
1813	27,193	16,926	15,983				60,102
1814	32,581	23,802	14,667				71,050
1815	33,202	24,594	28,794				86,590
1816	29,363	22,429	27,709				79,501
1817	28,494	16,911	10,819				56,224
1818	29,597	12,495	13,101	275			55,468
1819	36,994	19,681	25,188	559			86,423**
1820	33,005	22,043	19,217	11,028			91,108**
1821	27,871	22,406	8,372	10,909			73,769**
1822	33,212	18,220	14,689	10,708			81,348**
1823	37,609	24,117	24,558	13,637	6,633	3,304	100,676**
1824	44,187	20,317	23,792	13,711	16,692	3,919	122,618
1825	48,567	22,786	27,692	13,702	22,839	3,438	139,024
1826	41,040	18,228	24,494	13,862	38,922	5,260	141,806
1827	38,837			11,632	41,139	5,232	96,840
1828	40,044			1,398	45,136	591	87,159
1829	44,839				38,802	11,744	95,385
1830	47,835				36,031	11,898	95,764
1836	52,785			517	67,098	16,993	137,393
1840	66,006				3,841	13,540	83,387

* Includes -
* Westwood Colliery:

1798 - 6,575 tons
1799 - 5,655 tons
1800 - 321 tons

** Includes -
** Hnaugh Colliery:

1819 - 4,001 tons
1820 - 5,815 tons
1821 - 4,231 tons
1822 - 4,519 tons
1823 - 755 tons

APPENDIX XV

Coal Sales of the Fitzwilliam Collieries (tons)

Year	Elsecar New Colliery	Lowwood Colliery	Elsecar Old Colliery	Rainber Park Colliery	New Parkgate Colliery	Swallow-wood Colliery	Total Sales
1754/55			4,872				4,872
1768		8,784	2,262				11,046
1769		11,132	3,286				14,418
1770			2,822				2,822
1771			3,286				3,286
1779			592				592
1780			2,736				2,736
1793			5,811				5,811
1798	10,283	25,323	7,396				43,002
1799	21,800	23,074	7,619				52,493
1800	43,076	18,328	7,089				68,493
1801	38,189	12,228	12,176				62,593
1802	29,882	17,441	18,311				65,634
1803	33,613	18,674	17,312				69,599
1804	41,925	18,801	18,614				79,340
1805	35,566	27,287	15,391				78,244
1806	38,663	19,845	13,240				71,746
1807	39,155	19,322	12,855				71,332
1808	40,688	20,681	15,023				76,392
1809	45,807	20,028	14,734				80,569
1810	49,153	24,806	18,033				91,992
1811	49,504	24,732	17,651				91,887
1812	37,480	21,024	13,091				71,595
1813	30,642	19,290	16,706				66,638
1814	33,031	26,074	15,942				75,047
1815	32,652	24,720	28,161				85,533
1816	8,429	18,059	28,185				54,673
1817	24,904	14,731	9,035				48,670
1818	27,446	17,352	14,851	55			59,704
1819	31,939	17,074	25,081	7,109			84,641*
1820	30,281	21,889	19,303	9,433			80,906
1821	19,802	20,799	7,129	10,053			57,783
1822	27,547	22,013	15,683	11,146			76,389
1823	31,728	26,316	24,712	13,802	6,222	3,294	107,230*
1824	35,105	20,533	23,661	13,547	12,849	3,739	109,434
1825	39,022	21,476	27,490	13,579	27,066	3,596	132,231
1826	25,985	16,942	24,524	10,913	38,295	4,801	121,460
1827	35,366	14,634	23,858	6,869	39,923	2,754	123,404
1828	33,951	14,283	22,632	5,502	43,792	3,238	123,378
1829	31,814		22,541		40,953	12,003	
1830	30,278	14,714	19,870		35,752	11,715	112,329
1836	25,984	13,444	13,816	4,639	66,985	18,139	143,007
1840	29,110				73,579	13,420	

* Includes -

* Haugh Colliery:

1819, June-December: 3,438 tons

1823: ..... 1,156 tons

APPENDIX XVI

Fitzwilliam Collieries - Wage Cost per Ton of Coal (pence) *

Year	Elsecar New Colliery	Lowwood Colliery	Elsecar Old Colliery	Rainber Park Colliery	New Parkgate Colliery	Swallow-wood Colliery
1754/55			6.489			
1768		8.755	10.541			
1769		8.997	9.061			
1780			9.059			
1781		12.186	11.466			
1789		9.000	10.917			
1799	17.895	13.608	17.918			
1800	15.273	16.353	14.626			
1801	17.694	22.626	13.821			
1802	16.674	15.459	11.349			
1803	18.221	16.948	12.873			
1804	17.978	18.951	15.624			
1805	21.210	18.920	16.518			
1806	21.977	17.615	17.719			
1807	20.247	19.631	13.754			
1808	21.052	19.209	13.308			
1809	20.318	22.141	14.552			
1810	20.185	18.985	14.657			
1811	20.233	19.341	16.034			
1812	21.515	26.006	15.856			
1813	23.980	25.920	17.794			
1814	20.087	18.130	15.332			
1815	19.155	17.809	14.455			
1816	19.175	20.128	15.668			
1817	19.971	23.133	18.567			
1818	19.226	23.780	17.367	60.218		
1819	18.100	18.706	16.236	312.558		
1820	18.106	18 781	16.098	23.025		
1821	19.840	18.424	17.888	21.778		
1822	17.957	19.706	17.188	22.346		
1823	17.453	17.186	15.734	21.647	55.459	37.543
1824	17.191	17.766	16.634	24.523	38.059	34.714
1825	18.640	17.463	17.281	23.664	31.000	30.925
1826	22.000	22.436	16.726	25.174	27.039	31.340
1827	21.604			24.635	25.739	31.330
1828	21.301			49.452	25.544	55.635
1829	20.248			27.903	27.141	23.174
1830	18.634				26.903	26.808

1. Westwood Colliery — 1799 ..... - 18.886d per ton
   1800 ..... - 35.140d per ton
2. Rainber Park Colliery — 1818, November-December.
3. New Parkgate Colliery — 1823, June-December
4. Swallowwood Colliery — 1823, March-December
5. Haugh Colliery — 1819, June-December - 13.289d per ton

* Imperial Currency

APPENDIX XVII

SHEFFIELD PARK COLLIERY - MARCH 1781-JULY 1801

Year March-March	Coals Got Hard (Tons)	Coals Got Small (Tons)	Total Coal Output - Hard & Small (Tons)	Wage Cost per ton (pence)*2 (Getting, Heading, Filling, Hurrying)	Total Coal Sold at Sheffield Coal Yard (Tons)
1781-1782	3,678	12,382	16,060		16,074
1782-1783	3,679	13,927	17,607		17,607
1783-1784	3,291	12,748	16,039		16,044
1784-1785	4,167	16,515	20,682		21,516
1785-1786	3,655	15,700	19,435		22,066
1786-1787	2,775	14,073	16,848		18,373
1787-1788	3,429	15,522	18,951		20,509
1788-1789	2,132	10,348	12,480		15,300
1789-1790	2,570	8,700	11,270	35.201	2,010*1
1790-1791	3,332	18,691	22,023	22.700	21,996
1791-1792	3,430	19,573	23,003	24.425	23,017
1792-1793	3,184	22,639	25,823	27.110	25,825
1793-1794	3,077	19,721	22,798	28.813	22,639
1794-1795	3,422	11,611	15,033	32.151	14,967
1795-1796	4,188	12,928	17,116	30.326	17,141
1796-1797	4,148	12,976	17,124	31.348	17,110
1797-1798	3,289	13,137	16,426	38.032	16,564
1798-1799	3,615	12,688	16,303	35.714	16,952
1799-1800	4,925	17,309	22,232	32.321	22,234
1800-1801	5,217	18,134	23,351	33.701	23,263
1801-July 1801	1,370	4,830	6,200	33.716	

*1 March 28th, 1789 to August 29th, 1789. *2 Imperial Currency

* * * * *

APPENDIX XVIII

MANOR COLLIERY - MARCH 1781-MARCH 1801

Year March-March	Coal Output (Tons)	Wage Costs per ton (pence) *3 (Getting, Heading, Filling, Hurrying)	Coals Sold (Tons)
1781-1782	11,550		11,550
1782-1783	13,290		13,341
1783-1784	19,791		20,142
1784-1785	10,090**		15,870
1785-1786	7,174**		6,894
1786-1787	6,576**		6,576
1787-1788	5,742**		5,742
1788-1789	6,030**		6,048
1789-1790	3,015*2		5,562*1
1790-1791			
1791-1792			
1792-1793			
1793-1794	7,923	87.452	7,893
1794-1795	13,500	47.216	13,500
1795-1796	20,511	35.419	20,496
1796-1797	24,534	32.174	16,371
1797-1798	20,353	47.580	19,803
1798-1799	14,799	55.804	15,669
1799-1800	14,537	65.838	14,271
1800-1801	17,106	63.234	17,400

*1 March 28th, 1789 to January 23rd, 1790.

*2 March 16th, 1789 to August 29th, 1789. From August 29th, 1789 to March 27th, 1790 only income from coal sales.

** Includes the following small coal:

1784-1785	613 tons
1785-1786	2,335 tons
1786-1787	1,525 tons
1787-1788	1,536 tons
1788-1789	2,775 tons

*3 Imperial Currency

ATTERCLIFFE COLLIERY - DECEMBER 1788-MARCH 1801

Year (March-March)	Coal Output Hard (Tons)	Coal Output Small (Tons)	Total Output H & Sm (Tons)	Engine and Firepan - Hard (Tons)	Engine and Firepan - Small (Tons)	Total Engine & F'pan coal Hard & Small (Tons)	Total Engine & Firepan coal as percentage of total coal output
1788-1789	3,350	3,507	6,857				
1789-1790	18,703	15,743	34,446	327	5,256	5,583	16.15
1790-1791	20,288	16,168	36,456	385	5,514	5,899	16.18
1791-1792	19,794	19,730	39,524	354	5,353	5,707	14.44
1792-1793	18,141	17,178	35,319	342	5,494	5,836	16.52
1793-1794	20,766	18,745	39,511	335	5,430	5,765	14.59
1794-1795	12,302	16,274	28,576	376	5,342	5,718	20.01
1795-1796	12,848	22,051	34,899	373	5,057	5,430	15.56
1796-1797	14,150	19,241	33,391	362	5,072	5,434	16.28
1797-1798	12,583	18,356	30,939	355	3,597	3,952	12.77
1798-1799	12,501	20,830	33,331	357	3,640	3,997	11.99
1799-1800	17,664	26,010	43,674	372	8,063	8,435	19.31
1800-1801	16,281	28,257	44,538	363	3,207	3,570	8.02

Year (March-March)	1. Colliery Charges £ s d	2. Colliery Income £ s d	3. Balance £ s d	Profits and Interests on monies expended £ s d	5. Cost per ton (pence)
1788-1789	618 5 9½	758 12 4½	140 6 7		21.630
1789-1790	3,158 19 4½	4,577 13 5½	1418 14 1	620 1 1	21.917
1790-1791	4,195 11 7	5,605 2 8½	1409 11 1½	644 4 7½	27.624
1791-1792	3,865 9 1½	6,231 1 2½	2365 12 1	1,605 9 7	23.469
1792-1793	4,553 4 3½	6,485 9 11½	1932 5 8	1,138 2 8	30.939
1793-1794	5,590 0 11	7,592 8 6½	2002 7 7½	934 19 10½	33.955
1794-1795	5,170 1 1½	5,642 13 9½	472 12 8½		43.421
1795-1796	5,843 18 11	6,398 7 1½	554 8 2½		40.188
1796-1797	6,358 17 5½	6,676 13 2	317 15 8½		45.706
1797-1798	6,187 19 2½	7,012 5 5	824 6 2½		48.000
1798-1799	9,887 0 6				71.191
1799-1800	9,991 11 1	10,884 8 5	892 17 4		54.909
1800-1801	10,558 4 7½	11,740 19 2½	1182 14 7		56.893

Notes:

1 Expenditure largely refers to wages - getting, heading, onsetters, horse drivers, topsmen, blacksmith, engine charge, sundries.

2 Income largely coal sold, but also very small receipts - eg weighing - 12s 6d; old ropes 11s.

3 Includes wood from the Duke of Norfolk, Colliery Rent, Profits and Interest on monies expended:
(a) Colliery Rent £500 per annum
(b) Wood from Duke of Norfolk:

1789-1790	£298 13 0
1790-1791	£265 6 6
1791-1792	£260 2 6
1792-1793	£294 3 0
1793-1794	£567 7 9

4 December 1788-March 1789

5 Imperial Currency

* * * * *

APPENDIX XX

HESLEY COLLIERY 1790-1801

Date March-March	Coal Loads *1	Slack Loads *1	Heading and Board-gates Yards	Total Expenditure *2 £ s d
1790-1791	2661 15	238 15	449	862 0 7
1791-1792	3024 19	225	502.5	952 1 2½
1792-1793	3325 27	289	464	1,114 11 3½ *3
1793-1794	3265 6	552 15	731	1,066 4 0
1794-1795	2657	252	383.5	814 3 1½
1795-1796	2784	858	312	780 19 10½
1796-1797	2533 20	328	399	804 14 9½
1797-1798	3087	423	560.5	898 18 1½
1798-1799	3180	207	245	1,121 16 11
1799-1800	3133	338	327	968 18 1½
1800-1801	2595 15	332	312.5	1,007 19 4½

Notes: *1 30 corves = 1 Pit Load. Imperial Weight equivalent not available but as the cost per load was similar to the Attercliffe Colliery in 1790, a load of coal was probably 30 cwts at the Hesley Colliery.

*2 Total Expenditure includes items such as: wages, pit sinking, and capital equipment.

*3 1792-1793: A winding engine installed - £250.

* * * * *

APPENDIX XXI

Balances of the Sheffield Park, Manor, and Attercliffe Collieries 1781-1801

March-March	Sheffield Park Coll'y Balance £ s d	Sheff. Park Coll'y: Wood extracted from prev. column £ s d	Attercliffe Colliery. - Balance £ s d	Attercliffe Coll'y: Wood extracted from prev. column £ s d	Wood used by the Collieries £ s d
1781-1782	2103 19 8	280 4 6			
1782-1783	1988 0 6½	270 15 6			
1783-1784	2085 10 3½	355 4 6			
1784-1785	2227 15 11	507 15 0			
1785-1786*1	2518 8 1	452 8 1			
1786-1787	2860 12 3½	400 10 0			
1787-1788	3053 7 10	403 11 6			
1788-1789	2230 9 1½		140 6 7*2		
1789-1790	2396 10 1½		1418 14 1	298 13 0	
1790-1791	3370 17 6½	188 16 6	1409 11 1½	265 6 6	
1791-1792	4043 7 6	269 12 0	2365 12 1	260 2 6	
1792-1793	4075 8 9½	407 13 0	1932 5 0	294 5 0	
1793-1794	2507 8 5½	567 7 9	2082 7 7½	567 7 9	
1794-1795	1040 3 11		472 12 8½		
1795-1796	2099 8 4		554 8 2½		942 3 6
1796-1797	2300 4 6½		517 15 6½		815 4 6
1797-1798	2056 16 11		824 6 2½		1133 18 5
1798-1799	1690 11 4				1133 0 6
1799-1800	2990 9 1½		892 17 4		
1800-1801	200 12 9½		1182 14 7		

Notes:

*1 Includes Manor Colliery, 1785-1786 to 1801.

*2 December 1788 - March 1789.

APPENDIX XXII

Coal Income and Total Revenue of the Sheffield Estate

Date June-June	Total Balances of the Collieries £ s d	Total Rent from coal under lease £ s d	Total Revenue of *2 the Sheffield Estate £ s d
1778-1779		719 19 4	19,47[illegible] 17 10½
1779-1780		724 12 6	23,258 10 7
1780-1781		90 14 0	24,293 13 10½
1781-1782	2,103 19 8	153 3 0	25,182 0 11
1782-1783	1,988 0 0½	161 14 6	27,686 0 0½
1783-1784	2,085 10 3½	179 3 0	29,961 13 6½
1784-1785	2,227 15 11	164 3 0	30,738 2 9½
1785-1786	2,518 8 1	148 13 0	27,071 16 4½
1786-1787	2,860 12 3½	103 3 0	28,154 0 8
1787-1788	3,053 7 10	211 8 0	30,980 10 0½
1788-1789	2,370 15 8½	150 8 0	30,584 13 10
1789-1790	3,815 4 2½	283 6 0	31,080 1 6½
1790-1791	4,780 8 8	184 2 4	28,912 16 5½
1791-1792	6,406 19 9	136 9 5½	31,515 5 11
1792-1793	6,007 14 5½	531 9 7½	35:133 19 11½
1793-1794	4,509 16 1	236 8 7	40,776 0 8
1794-1795	2,412 16 7½	3 3 0	46,568 12 9½
1795-1796	2,655 16 6½	24 3 0	42,479 5 5½
1796-1797	2,698 0 3	796 13 6*	42,055 3 2
1797-1798	2,661 3 1½	3 3 0	42,900 2 5½
June 1798-Dec 1799	3,883 6 5½	529 10 6*	54,239 11 6½
Jan-Dec 1800	1,383 7 4½	69 14 10½	45,864 11 1½
1801		115 14 3	49,005 11 3½
1802		139 6 1	48,451 17 4
1803		353 16 0	48,622 4 5½
1804		53 3 0	48,173 0 10½
1805		142 1 10½	50,286 0 9½
1806		5 0 0	43,657 7 5
1807		973 16 0*	41,877 6 1½
1808		2,758 16 0*	51,464 15 8
1809		756 6 0	41,472 10 10½
1810		981 6 0*	56,680 4 6
1811		2,683 16 0*	42,876 5 5
1812		756 6 0	55,027 1 8
1813		2,053 3 0*	35,669 6 2
1814		2,078 15 0*	46,298 19 6½
1815		1,587 10 0*	37,924 19 8½
1816		1,512 10 0*	16,907 19 2½
1817		1,673 5 7½*	26,758 7 5
1818		1,908 13 1½*	24,358 19 11½
1819		1,912 15 10½*1	25,111 17 4½
1820		2,856 15 0*1	28,056 4 7½
1821		3,132 0 9*1	30,040 6 6
1822		5,306 1 3*1	28,378 12 6½
1823		5,751 17 6*1	30,154 9 7½
1824		5,110 14 6*1	28,441 6 9
1825		5,185 13 9*	29,068 12 10½
1826		5,583 18 8*1	29,121 19 4½
1827		4,770 9 10*	26,528 3 7½
1828		4,984 11 2*1	24,597 2 9½
1829		6,008 14 3*	26,743 17 3½

Notes: * Coal and Ironstone
*1 Coal and Quarries
*2 Include rents from agriculture, quarries, forges, mills and collieries under lease, but not revenue from the collieries under direct estate management

APPENDIX XXIII

THE EXPENSE ACCOUNTS OF THE FITZWILLIAM COLLIERIES

Date Jan-Dec	Elsecar New Colliery £ s d	Lowwood Colliery £ s d	Elsecar Old Colliery £ s d	Rainber Park Coll'y £ s d	New Park-gate Coll'y £ s d	Swallowwood Colliery £ s d	Haugh Colliery £ s d
1794	640 6 4½						
1795	2022 14 8						
1796	1811 14 4½						
1797	1853 14 1½	515 15 8½					
1798	2407 1 4½	1279 5 11½					
1799	2530 3 1½	862 6 8½	103 9 6½				
1800	1721 9 1	342 15 6½	254 14 4½				
1801	1808 8 11	648 3 4½	294 4 3½				
1802	1700 3 8	772 11 11½	181 15 0½				
1803	2002 4 3	626 13 3½	317 13 10				
1804	3842 8 6½	1882 6 1½	336 12 8½				
1805	2760 10 7½	1894 12 11	606 8 8½				
1806	2295 10 0½	863 13 9½	455 5 0				
1807	2489 12 11½	598 10 7½	484 4 2				
1808	2124 1 8½	745 16 3	431 12 8				
1809	2330 7 10½	2857 10 8	261 8 0½				
1810	2293 6 1½	1186 4 7½	946 16 8½				
1811	1726 8 4½	2205 10 9½	583 1 9½				
1812	3184 12 2	1505 3 0	1170 2 8				
1813	1499 6 2½	791 6 0½	1287 7 7½				
1814	1775 7 11½	1124 2 8½	1000 8 4½				
1815	2128 13 0	1795 3 3	1533 14 5				
1816	1601 14 0½	1690 15 7½	1039 16 1½				
1817	1542 9 2	551 1 0½	948 8 1½	*1			
1818	1495 2 3½	326 5 5½	843 9 1½	303 4 3½			*4
1819	1662 12 4	252 19 8½	963 1 1½	586 3 7			464 12 9
1820	1733 11 7½	530 5 7½	854 3 5½	2796 7 3½	*2		43 6 5½
1821	1112 12 3½	795 8 6½	556 3 10½	632 17 7½	6807 7 10½		26 10 4½
1822	1153 [illegible] 9½	579 13 4	811 6 6	572 2 2½	7756 11 7½	*3	95 7 0½
1823	1596 16 11½	722 18 11	990 13 6½	492 15 9	8924 13 0½	79 5 6	0 8 6
1824	1976 1 7½	730 13 2	864 18 1½	330 4 10½	5037 6 9½	238 2 4	
1825	3676 17 11½	763 6 0½	3029 4 10½	431 5 8	5236 3 10½	1166 17 6	
1826	1576 1 2½	668 16 9	967 7 0	1058 1 11½	5264 11 4	104 2 6½	
1827	1941 2 8½	465 9 4½	2254 14 1½	639 0 2½	8100 14 9	377 11 3½	
1828	1505 18 2½	493 16 11	890 10 10½	271 6 7	4715 19 6	63 8 2½	
1829	1580 7 10½	25 18 1½	1014 10 10½	18 8 11	4199 5 6	336 1 9	
1830	1568 0 11½	172 6 0½	836 9 4½	169 2 3	4294 19 0½	48 7 11	

Notes:

*1 November-December 1818

*2 June 7 - December 31, 1821

*3 March 29 - December, 1823

*4 June - December 1819

APPENDIX XXIV

BALANCES OF THE FITZWILLIAM COLLIERIES

Date	Elsecar New Colliery £ s d	Lowwood Colliery £ s d	Elsecar Old Colliery £ s d	Westwood Colliery £ s d	Rainber Park Colly £ s d	New Park-gate Colly £ s d	Swallowwood Colliery £ s d	Haugh Coll'y £ s
1794		1587 9 3½	54 3 10½					
1795	23 8 0	1980 9 3½	332 17 8	47 12 5½				
1796	31 5 8	2003 17 1½	957 0 3½	238 17 6½				
1797	377 0 6½	1899 11 11½	143 4 10½	51 9 5½				
1798	399 6 11½	1855 10 3½	833 16 7	216 0 6½				
1799	1923 18 9½	1251 6 6½	19 6 10	170 18 8				
1800	4214 4 4½	2100 12 5	1233 18 6¾	613 9 3½				
1801	4032 19 11½	1200 6 1½	848 5 10¼					
1802	2036 14 11½	1458 0 9½	2561 18 10¼	11 8 2½				
1803	3198 4 2	1858 5 6½	2000 12 6½					
1804	3611 11 1½	1148 5 3	1469 9 4½					
1805	3529 9 0½	2970 4 5½	2054 13 5½					
1806	3439 8 8½	1517 5 4	1045 3 10¼					
1807	4900 7 7½	2400 19 9½	1633 5 1½					
1808	3672 9 10¼	1586 4 8½	1917 6 0½					
1809	5193 11 5½	1355 10 0	1425 0 11					
1810	5582 11 3½	2177 13 4	2181 18 5½					
1811	5083 10 11½	2170 12 1½	1804 16 10½					
1812	4976 13 11½	1128 7 0½	989 16 3¾					
1813	4384 1 5½	1553 19 4	1641 3 5½					
1814	4945 17 9	2895 17 5½	1661 10 8½					
1815	5803 0 8½	2578 10 4½	4134 8 6½					
1816	3852 12 5½	1800 5 1½	5250 10 8½					
1817	5295 3 9½	1458 8 3½	451 12 3½					
1818	4427 4 11½	2103 18 2	1966 12 9		5 14 3 *1			*4
1819	3636 0 1½	1658 14 2½	3618 17 11½		85 0 4½			34 14 3¼
1820	5401 16 11	2364 15 7½	3415 11 11½		465 17 7½			278 17 1½
1821	2826 7 1	1989 2 8	980 16 11½		855 13 3½			368 9 3
1822	5807 1 6½	2658 5 1	2013 13 3		1404 13 3½	*2	*3	545 14 0½
1823	5390 7 10½	3603 12 5½	2323 14 3½		1536 6 4½	405 6 11	54 1 2½	303 17 5½
1824	6499 4 3½	2549 1 5	-207 7 10½		961 0 10	489 10 1½	378 2 1	
1825	6091 14 5½	2476 14 8½	6743 19 3		1409 15 1½	3239 12 5½	588 2 2½	18 14 4½
1826	2253 10 6	1887 19 5½	-2057 15 10		238 13 11½	4706 9 6	319 0 2	
1827	9692 8 7½	1776 16 11	-1854 6 6½		326 7 8½	4823 14 5	-64 18 10	
1828	6083 18 7½	1499 1 9	1507 4 7		799 14 7½	5054 4 10½	540 8 2½	
1829	5205 8 8		-1898 4 8		362 8 4½	3445 0 6½	1260 6 5½	
1830	5475 4 2½	2061 11 10½	-2221 7 9½		129 13 10½	3030 3 4	787 1 7½	
1836	4651 1 8	639 13 9¼	3006 11 4½		493 10 8	9124 11 4		
1840	8027 3 4					9915 0 3½		

Notes:

*1 November-December 1818

*2 June 7 - December 31, 1823

*3 March 29-December, 1823

*4 June-December 1819

APPENDIX XXV

WENTWORTH ESTATE COAL REVENUE

Date Jan-Dec	Lowwood *1 Colliery Balances			Elsecar Old *1 Colliery Balances			Total Balances			Total Revenue *2 from coal under lease on the Wentworth Estate			Total Revenue *3 of the Wentworth Estate includ. agricultural & coll'y rents		
	£	s	d	£	s	d	£	s	d	£	s	d	£	s	d
1768	421	0	11	182	2	3	603	3	2	1,091	0	0	8,392	2	6½
1769	689	17	4½	109	0	0	898	17	4½	359	7	10½	7,750	8	6½
1770	881	18	8½	79	15	0	961	13	8½	1,852	12	1½	8,200	3	0½
1771	544	4	11½	187	18	1½	732	3	1	760	0	0	8,466	18	5½
1772	609	5	5½	90	7	10	699	13	3½	849	16	7½	9,110	8	8½
1773	619	17	4	105	15	4	725	12	8	930	3	4½	8,798	5	10½
1774	788	19	9	84	11	0½	873	10	9½	900	0	0	9,888	14	11½
1775	855	8	9½	106	8	1½	961	16	11	875	0	0	10,128	8	10
1776	911	5	5	116	8	11½	1,027	14	4½	835	0	0	10,476	5	10
1777	1,015	7	2	110	1	0½	1,125	8	2½	885	1	7½	9,766	13	10½
1778	1,150	14	11½	117	11	4½	1,268	6	4½	759	12	3	10,272	15	11
1779	1,331	3	9½	110	17	4½	1,442	1	1½	933	18	9	11,197	4	3½
1780	1,377	12	0½	104	15	1½	1,482	5	2½	1,246	12	3	12,749	13	10½
1781	1,397	10	8	127	6	1½	1,524	16	9½	2,388	12	4½	14,555	6	8½
1782	1,036	15	4½	114	5	8½	1,151	1	0½	2,146	16	4½	9,009	14	4½
1783	1,490	0	5	147	9	5½	1,637	9	8½						
1784	1,583	7	3½	89	2	5½	1,672	9	9½	2,367	10	0	14,274	3	9½
1785	1,133	16	8	71	18	11½	1,205	15	7½	1,780	16	11	14,769	15	5
1786	1,549	18	1½	111	8	1	1,661	6	2½	2,351	6	4½	15,737	12	8½
1787	1,490	19	7½	129	9	3½	1,620	8	11	1,618	7	1½	15,066	8	4½
1788	2,102	17	7½	261	3	1	2,364	0	8½	3,112	16	8½	16,153	15	5
1789	1,726	9	7	92	15	2	1,819	4	9	2,951	12	10½	15,789	0	5½
1790	1,958	5	2½	154	16	5½	2,113	1	8	2,300	0	0	15,274	15	9½
1791	1,691	19	1½	330	18	8½	2,022	17	10	2,350	0	0	15,092	4	7
1792	1,744	11	8	191	3	5	1,935	15	1	2,340	0	0	15,122	15	9
1793	1,615	15	9	321	1	7	1,936	17	4	1,078	7	1½	15,062	8	11½

Notes: *1 Extracted from the Household General Accounts

*2 Extracted from the Wentworth Estate Accounts

*3 Extracted from the Wentworth Estate Accounts

Does not include the colliery 'balances'.

APPENDIX XXVI

WENTWORTH ESTATE COAL REVENUE

Date	*1 Total Coll'y Balances £ s d	Total Coll'y 'Expenses' £ s d	*2 Total 'Net Profit' of the Collieries £ s d	Total Revenue from coal under leases £ s d	*3 Total Revenue of the Wentworth Estate includ, agricultural & Coll'y rents £ s d
1794	1,642 1 5½	640 6 4½	1,001 15 0½	2,300 17 0	16,731 15 4
1795	2,383 7 4½	2,022 14 8	341 12 8½	2,876 9 1½	16,993 8 10
1796	3,249 0 7½	1,811 14 4½	1,437 6 3½	1,547 13 10½ *4	16,862 7 5½
1797	2,471 6 11½	2,369 9 9½	101 17 1½	2,575 2 6 *4	19,153 2 9
1798	3,304 14 4½	3,676 5 3½	-372 10 11½	2,537 13 9 *4	19,729 13 4½
1799	3,365 10 9½	3,495 19 4½	-130 8 6½	1,818 12 5 *4	19,371 15 0½
1800	8,162 4 7½	2,318 18 11½	5,843 5 8	1,766 1 3 *4	20,685 3 5½
1801	6,081 11 11½	2,750 16 7½	3,330 15 4½	5,292 11 8½	24,591 9 7½
1802	6,068 2 10½	2,472 15 7½	3,595 7 3½	1,796 0 0	23,112 6 11½
1803	7,057 2 2½	2,946 11 4½	4,110 10 10½	5,367 1 3	24,672 15 6½
1804	6,229 5 9½	6,061 7 4½	167 18 4½	4,404 14 0	21,890 4 9½
1805	8,554 6 11½	5,261 12 2½	3,292 14 8½	2,976 14 0	19,403 2 3½
1806	6,002 7 11½	3,614 8 10	2,387 19 1½	2,721 18 4	20,683 16 1
1807	8,934 12 6½	3,572 7 8½	5,362 4 10	3,797 7 5	20,884 6 8½
1808*5	7,176 0 6½	3,301 10 8½	3,874 9 10½	1,899 4 1	14,134 18 7½
1809*6	7,972 2 4½	5,449 6 7	2,522 15 7½	3,205 3 9	22,312 8 10
1810	9,942 2 10½	4,426 7 6	5,515 15 4½	3,336 13 9	22,178 6 2½
1811	9,058 19 11½	4,515 0 11½	4,543 19 0½	1,971 18 9	31,209 17 9½
1812	7,094 17 3½	5,659 17 10	1,434 19 5½	3,411 17 6	35,874 2 3½
1813	7,579 4 2½	3,577 19 10	4,001 4 4½	4,705 11 3	36,345 9 8½
1814	9,503 5 11	3,900 19 0½	5,602 6 10½	3,445 18 9	33,660 4 1½
1815	12,515 19 8	5,457 10 8	7,058 9 0	2,775 8 9	34,684 16 7½
1816	10,883 8 3½	4,332 5 9½	6,551 2 6½	2,344 7 6	36,663 1 5½
1817	7,205 4 4½	3,041 18 3½	4,163 6 0½	877 5 0	34,383 9 0½
1818	8,503 10 1½	2,968 1 0	5,535 9 1½	5,375 12 6	38,665 0 10
1819	9,033 6 11½	4,129 9 5½	4,903 17 6	2,983 10 0	33,003 18 6¾
1820	11,926 19 3	5,958 0 5½	5,968 18 9¾	1,488 0 0	32,754 13 1½
1821	7,020 9 3½	9,931 0 4	2,910 11 0½	1,538 7 6	34,494 4 7½
1822	12,429 7 2½	10,968 9 5	1,460 17 9½		
1823	13,917 6 7½	12,807 12 2½	1,109 14 4½		
1824	10,669 10 10½	9,177 6 10½	1,492 3 11½		
1825	22,568 12 7½	14,303 15 10½	8,264 16 8½		
1826	7,337 17 9½	9,639 0 9½	-2301 3 0½		
1827	14,700 1 10½	13,778 12 5	921 9 5½		
1828	16,484 12 8½	7,961 0 3½	8,523 12 4½		
1829		7,174 13 0½			
1830	9,262 7 1½	7,189 5 7½	2,073 1 5½		

Notes:

*1 Extracted from the General Household Accounts

*2 The difference between total balances and 'expenses' W.W M. F105

*3 Extracted from the Wentworth Estate Accounts :
Does not include colliery balances

*4 Includes ironstone revenue from the Thorncliffe Ironworks

*5 January-July 1808

*6 July-June 1809-1830

A SELECT BIBLIOGRAPHY

(Note: Only those sources quoted in the footnotes are cited in the bibliography.)

MANUSCRIPT COLLECTIONS

(Located in the Sheffield City Library)

Arundel Castle Muniments

Bland Collection

Fairbanks Collection

Newman and Bond Collection

Wentworth Woodhouse Muniments

PARLIAMENTARY PAPERS

Reports from Committees of the House of Commons, Volume X, 1785-1801.

Reports from Committees on the Coal Trade 1800: Commons Reports, first series, Volume X, pp. 537-650.

PUBLISHED WORKS

(Unless otherwise stated, London is the place of publication)

D. Anderson, The Orrell Coalfield, Lancashire, 1740-1850 (Buxton, 1975).

T.S. Ashton, An Economic History of England: The Eighteenth Century (1929).

T.S. Ashton, Economic Fluctuations in England, 1700-1800 (Oxford, 1959).

T.S. Ashton, Iron and Steel in the Industrial Revolution (Manchester, 1924).

T.S. Ashton and J. Sykes, The Coal Industry of the Eighteenth Century (Manchester, 1929).

T.W. Beastall, A North Country Estate: The Lumleys and Saundersons as Landowners, 1600-1900 (Chichester, 1975).

M.K. Buxton, The Economic Development of the British Coal Industry (1978).

J. Curr, The Coal Viewer and Engine Builders' Practical Companion (Sheffield, 1797).

J. Davies, Cardiff and the Marquesses of Bute, Studies in Welsh History 3, (Cardiff, 1981).

B.F. Duckham, A History of the Scottish Coal Industry: A Social and Industrial History, 1700-1815, Volume 1, (Newton Abbot, 1970).

E. Elmhirst, A History of the Elmhirsts: The Peculiar Inheritance, (place of publication not stated, 1951)

W. Fordyce, A History of Coal, Coke, Coalfields and Iron Manufacture in Northern England (Newcastle-upon-Tyne, 1973) (first edition, 1860).

R.L. Galloway, Annals of Coal Mining and the Coal Trade, Volume 1 (Newton Abbot, 1971).

A.D. Gayer, W.W. Rostow and A.J. Schwartz, The Growth and Fluctuation of the British Economy, 1790-1850, Volume 1 (1975).

J. Goodchild, The Coal Kings of Yorkshire (Wakefield, 1978).

A.H. Green and R. Russell, Geology of the Yorkshire Coalfield (1878)

A.R. Griffin, Mining in the East Midlands, 1550-1947 (1971).

C. Hadfield, The Canals of Yorkshire and North-East England (Newton Abbot, 1972).

J. Hunter, Hallamshire (Sheffield, 1869).

J. Hunter, South Yorkshire, Volume 2 (1831).

J.T. Jeffcock, Parkin Jeffcock: Civil and Mining Engineer: A Memoir by his brother, J.T. Jeffcock (1867).

R.E. Leader, Sheffield in the Eighteenth Century (Sheffield, 1901)

F. Machin, The Yorkshire Miners, Volume1 (1958).

W.K. Martin, History of Wath-upon-Dearne (Wath, 1920).

G. Mee, Aristocratic Enterprise (Glasgow, 1975).

G.E. Mingay, English Landed Society in the Eighteenth Century (1963).

B.R. Mitchell and P. Deane, Abstract of British Historical Statistics (Cambridge, 1962).

J.U. Nef, The Rise of the British Coal Industry, 2 Volumes (1932).

S. Pollard, The Genesis of Modern Management; A Study of the Industrial Revolution in Great Britain (1965).

L. Presnell (ed.), Studies in the Industrial Revolution (1960),

J. Priestley, Historical Account of the Navigable Rivers, Canals and Railways of Great Britain (1831).

J.F. Prince, Parish of Silkstone (Penistone, 1922).

A. Raistrick, Dynasty of Iron Founders: The Darbys and Coalbrookdale (Newton Abbot, 1970).

A. Raistrick (ed.), The Hatchett Diary: A Tour through the Counties of England and Scotland in 1796. Visiting Mines and Manufactories (Truro, 1967).

T.J. Raybould, The Economic Emergence of the Black Country (Newton Abbot, 1973).

F.M.L. Thompson, English Landed Society in the Nineteenth Century (1963).

B. Trinder, The Darbys of Coalbrookdale, (Chichester, 1978).

J. T. Ward and R.G. Wilson (eds.), Land and Industry: The Landed Estate and the Industrial Revolution, (Newton Abbot, 1971).

J. Wilkinson, Worsbrough: Its Historical Associations and Rural Attractions, (Barnsley, 1872).

A. Young, A Six Months' Tour through the North of England, Volume 1, (1769).

ARTICLES

A.K. Clayton, "Coal Mining at Hoyland", Transactions of the Hunter Archaeological Society, Volume IX (1966).

A.K. Clayton, "The Newcomen-Type Engine at Elsecar, West Riding,", Transactions of the Newcomen Society, Volume XXXV (1962-63).

D. Hey, "The Ironworks at Chapeltown", Transactions of the Hunter Archaeological Society, Volume 10 (1977).

G.G. Hopkinson, "The Development of Inland Navigation in South Yorkshire and North Derbyshire 1697-1850", Transactions of the Hunter Archaeological Society, Volume 7 (1951-57).

G.G. Hopkinson, "The Development of the South Yorkshire and North Derbyshire Coalfield, 1500-1755", Transactions of the Hunter Archaeological Society, Volume 7 (1951-57).

G.G. Hopkinson, "Railway Projection and Construction in South Yorkshire and North Derbyshire 1830-50", Transactions of the Hunter Archaeological Society, Volume 9 (1964-9).

P. Jeffcock, "On the Coal and Iron Mining of South Yorkshire,", The Institute of Mechanical Engineers, (1862).

R. A. Mott, "Tramroads of the Eighteenth Century and their originator - John Curr,", Transactions of the Newcomen Society, Volume XLII, (1969-70).

S. Pollard, "Barrow-in-Furness and the Seventh Duke of Devonshire", Economic History Review, 2nd series, Volume 8, (1955-6).

H. Rhodes and H. Rhodes, "Methods of Working the Barnsley Seam of the South Yorkshire Coalfield", Transactions of the Institute of Mining Engineers, Volume 63 (1921-22).

E. Richards, Review of the book by G. Mee: Aristocratic Enterprise: The Fitzwilliam Industrial Undertakings, 1795-1857, (Glasgow, 1975); Economic History Review, 2nd series, Volume 29 (1976).

G. Rimmer, "Middleton Colliery (1770-1830)", Yorkshire Bulletin of Economic and Social Research, Volume 7 (1955).

H. E. Saul, "Outcrop Water in the South Yorkshire Coalfield,", Transactions of the Institute of Mining Engineers, Volume XCII (1934).

E. Sorby, "Coal Mining near Sheffield from 1737 to 1820", The Midland Institute of Mining, Civil and Mechanical Engineers, Volume LXV (1923)

D. Spring, "The Earls of Durham and the Great Northern Coalfield, 1830-1880", Canadian Historical Review, Volume 33 (1952)

D. Spring, "Earl Fitzwilliam and the Corn Laws", American Historical Review, Volume 59 (1953-4)

D. Spring, "The English Landed Estate in the Age of Coal and Iron, 1830-1880", Journal of Economic History, Volume 11 (1951)

L. Stone, "An Elizabethan Coalmine", Economic History Review, 2nd series, Volume 3 (1950-51)

J.T. Ward, "The Beaumont Family's Estates in the Nineteenth Century", Institute of Historical Research Bulletin, Volume 35 (1962)

J.T. Ward, "The Earls Fitzwilliam and the Wentworth Woodhouse Estate in the Nineteenth Century", Yorkshire Bulletin of Economic and Social Research, Volumes 11-12 (1959-60)

J.T. Ward, "West Riding Landowners and Mining in the Nineteenth Century", Yorkshire Bulletin of Economic and Social Research, Volumes 15-16 (1963-4)

J.T. Ward, "West Riding Landowners and the Railways", Journal of Transport History, Volume 4 (1959-60)

J.E. Williams, "Whitehaven in the Eighteenth Century", Economic History Review, 2nd series, Volume 8 (1955-6)

O. Wood, "A Cumberland Colliery during the Napoleonic War", Economica, N.S. Volume 21 (1954)

A.S. Ellis, Yorkshire Deeds (part II) Yorkshire Archaeological Journal, Volume 12 (1893)

WORKS OF REFERENCE

The Complete Peerage, G-E-C, Volume IX (1936)

Geology of the Country Around Barnsley (1947)

Sheffield Local Register 200-1857, Volume 1 (Sheffield, 1830)

Directory of Sheffield, 1787 (reprinted Sheffield, 1889)

Directory of Sheffield, 1797 (Sheffield, 1797)

NEWSPAPERS AND PAMPHLETS

Sheffield Newspaper Cuttings, Volume 27, (1933), Sheffield City Libraries

A. Gatty, The Noble and Illustrious Family of Howard. Local Pamphlets, Volume 119, (1879), Sheffield City Libraries

G.D. Lewis, The South Yorkshire Glass Industry (Sheffield City Museum, 1973)

UNPUBLISHED WORKS

A.K. Clayton, 'A Study of the Parliamentary Enclosure in Hoyland' (unpublished typescript, Sheffield City Library, 1957)

R.M. Cox, 'The Development of the Coal Industry in South Yorkshire before 1830' (unpublished M.A. thesis, University of Sheffield, 1960)

C.P. Griffin, 'The Economic and Social Development of the Leicestershire and South Derbyshire Coalfield 1550-1914' (unpublished Ph.D. thesis, University of Nottingham, 1969)

G.G. Hopkinson, 'The Development of Lead Mining of the Coal and Iron Industries in North Derbyshire and South Yorkshire 1700-1850' (unpublished Ph.D. thesis, University of Sheffield, 1958)